Pacific Discovery

COCONUT-EATERS

PUBLISHED BI-MONTHLY BY THE CALIFORNIA ACADEMY OF SCIENCES

IN THIS ISSUE: *Wilbert M. Chapman* • *Vinson Brown*
Grace Irene Crowe • *Joel Hedgpeth* • *Earle G. Linsley*
Borys Malkin • *Edward S. Ross*

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Pacific Discovery

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Pre-Discovery:

Of a natural phenomenon as long known and widely celebrated as the Big Tree, *Sequoia gigantea,* amazingly little has been published on one vital phase: its infancy and youth. Not all Big Trees are grizzled patriarchs of 2,000 years or more, nor are they necessarily a doomed race. An eminent California forester will tell in the May-June PD the little-known story of their life from tiny seed to vigorous prime, with a look to their future. ¶ Scientists who study earthquakes and volcanoes "fully expected something spectacular in 1947. It failed to come. But . . the stage is still set"—say the authors of "Where is Our Next Volcano?" who will remind us, with no intent to alarm, that the Pacific coast is on the earth's great "circle of fire." ¶ Palomar and the 200-inch reflector will be the subject of May-June Astronomy pages.

Discovering PD's Authors:

Wilbert M. Chapman saw "Coconut-Eaters" – both two-legged and eight-legged—in action during World War II when, on leave from the Academy, he was Senior Fisheries Specialist with the Office of Economic Warfare in the Southwest Pacific. Later, with the Foreign Economic Administration, he had more Pacific duty before returning to his post as Curator of Fishes at the California Academy of Sciences. Dr. Chapman is now Director of the School of Fisheries of the University of Washington.

From typhoons in the Japan Sea to army ants sweeping the Panama jungle, **Vinson Brown**—who takes us this time to the "Edge of the Desert"—cannot resist the urge to share his own varied experiences of nature with others, through writing and speaking. This urge has also, through his teaching and leadership, given a great many young people their first enthusiasm for nature, through understanding. His *Amateur Naturalist's Handbook* will be published this year by Little, Brown & Company.

Grace Irene Crowe's swivel chair in the Academy's Department of Birds and Mammals has been, during the five years of her occupancy, the seat of many activities besides "Swivel Chair Birding." By virtue of other qualifications than an ornithological surname, Miss Crowe is Editor of *The Gull,* official journal of the Audubon Association of the Pacific.

The name of **Joel Hedgpeth** is familiar to readers of such journals as the *Scientific Monthly,* who have found him an original thinker and philosopher as well as skillful writer and sound biologist. His headquarters are the Institute of Marine Science of the University of Texas, at Port Aransas. "Gold, Men and Fish" should provoke thought in a California celebrating this year the centennial of the discovery of its gold. Men and fish are also part of these hills and river valleys.

Introduced in the January-February PD, Dr. **Earle G. Linsley** continues his Astronomy pages with "Stars of Early Spring and Summer."

Writing from London, **Borys Malkin,** Academy Research Associate, summarizes for PD's new department, Roads to Discovery, what he learned during a long summer on his own in Mexico as an entomologist collecting for museums. Soon going to Africa to collect specimens and field data for the Academy, he is completing work at London University for a degree in Anthropology.

Having led several expeditions into Mexico in the Academy's field truck, Dr. **Edward S. Ross,** Curator of Insects, is the best man we could have asked for advice to anyone planning to try Mexico's rougher auto roads. A veteran of this kind of going, he calls Cape San Lucas "one of the most difficult motoring goals on the Pacific coast." **D.G.K.**

FROM THE READER

SIRS:

I want to send you my very warm congratulations on the first number of your *Pacific Discovery*—a beautiful number, well planned and cleverly edited. I am sure the magazine will be useful and widely welcomed.

Every article in this issue is delightful, fascinating reading. I am confident that your Foreword will be an inspiring guide to a great future.

With best wishes to you.

GILBERT GROSVENOR
Editor

National Geographic Magazine
Washington, D.C.

SIRS:

This is to thank you for the copy of the first issue of *Pacific Discovery* the advent of which we have been looking forward to for some time. Something like this high plane magazine backed by a strong institution, but for popular reading, has been needed to carry the torch for conservation on the Pacific coast. We were particularly happy over your having included Murie's article on Jackson Hole.

The issue is being routed throughout our staff, and I have a note from our Biologist, Lowell Sumner, which reads:

"This is an impressive first issue. *Every* article was interesting. If it can keep this up, *Pacific Discovery* will be way out in front very soon."

O. A. TOMLINSON
Regional Director

National Park Service
Region Four, San Francisco.

SIRS:

Congratulations on a beautifully done issue. Keep up the good work on conservation.

W. I. HUTCHINSON, *Chief*
by C. E. FOX

U. S. Forest Service
California Region, San Francisco.

SIRS:

Accept my congratulations on the initial edition of "Pacific Discovery." I have digested it with gusto, and am looking for more.

EDWARD F. DOLDER
Educational Supervisor

California Division of Beaches and Parks
Sacramento.

SIRS:

. . . Read every article at one sitting. Each one proved very interesting and I was fascinated with the excellence of the pictures. I am sure the magazine will receive wide accord, and fill a real need, especially on the Coast.

E. L. PACKARD
Head

Department of Geology
Oregon State College, Corvallis.

SIRS:

. . Words fail to express my admiration and joy over the first issue of *Pacific Discovery*. Good for you!

(MRS.) ANNA S. NEWHALL

Berkeley.

SIRS:

. . I am pleased. All the articles are written in a manner I like and understand. They are short, to the point, and yield abundant knowledge.

L. G. DARLING

Portland.

SIRS:

I am delighted with PD and quite excited about its limitless possibilities. I am particularly glad to see that you are devoting a section to conservation. That is surely a sorely needed department and one where so many of us can meet on common ground. May I express the hope that you will stress the part the ocean and seashore play in our lives . . . emphasizing the need for conserving our shoreline for recreation and wilderness purposes? It seems to me to be in even greater danger of being lost to posterity than our mountain and other inland areas—and there is so much less shoreline than "hinterland."

My sincere good wishes for the success of this Pacific enterprise.

MINNA N. (MRS. WM. C.) EIDENMULLER

San Francisco.

PD is planning an article on the conservation of our beaches for one of this summer's issues.—EDITORS.

SIRS:

During the past 18 or 19 years that I have been a member, I have enjoyed the privileges of the Academy, and to the extent that, as a layman, I could comprehend them, the technical papers have been very interesting.

PD does really bridge the gap. . . . Permit me to thank the Board of Trustees, the officers, the scientific and research staffs for the past publications and, with the editorial staff, for the new bi-monthly.

M. RICHARD OBITZ

San Francisco.

It is our hope that many old members, like Mr. Obitz, and our hundreds of new members and subscribers, are finding that PD does bridge the gap between the Academy's technical papers (which will, of course, continue) and the kind of stuff which is so far "popularized" or rehashed in the Sunday supplements it is no longer to be relied upon as science.—EDITORS.

SIRS:

Your prospectus, the one bearing a sailing ship picture [*subsequently the cover picture of the first issue.*—ED.], was forwarded to me from my home in Hawaii. Judging from the contents of the January-February issue, and that is all I have to go on, the title "Pacific Discovery" is a misnomer. My interest in the publication dropped when it appeared that the "Pacific Area" means San Francisco and points lying east, and that to reach these places (such as Jackson Hole) a covered wagon would be more appropriate than a sailing ship. Are Polynesia, Micronesia, the Society Islands, New Zealand and New Guinea to be neglected?

JOHN E. MANGELSDORF

Zürich, Switzerland.

No. The Pacific area is rather large; it will take PD, we hope, a good many years to cover it.—EDITORS.

Coconut Crab survivor of atomic bomb tests at Bikini spurns with an air of contemptuous indifference a half coconut fresh from a San Francisco fruit stall. He'll pick his own, thank you. (Photograph by Frank Lee Rogers)

WILBERT M. CHAPMAN

Coconut-Eaters

THERE ARE TWO ACCOMPLISHMENTS of normal life in the South Seas in which the casual white visitor finds it difficult to attain any degree of expertness. These are, climbing a coconut palm and breaking into a coconut to get at the meat. Natives of even tender years can do both things with that éclat which is reserved to the masters of any art. It is jarring to the general tenet of white supremacy to find the dark races, to a man, so far ahead of one in such seemingly simple tricks of manual, and pedal, dexterity; but it is downright upsetting to find a crab climbing the slick bole of a coconut palm with the ease of long practice, or to find a crab calmly eating a coconut which one has thrown away in disgust after hacking and chopping at it without getting in as far as the nut.

Most coconuts which find their way to market are hard-shelled nuts which can be broken into easily with a light hammer, but this is not the way they grow. On the tree they are cased in a husk of the toughest fiber an inch or more thick, for they are built specifically to resist the abrasive action of surf and coral when they are cast on a reef after floating in the sea. It is surprising how long you can whittle on this husk without getting inside to the nut. Any native will show you that this is not the proper method of attack; the correct way is to set a sharply pointed stick in the ground, point up, and crack the husk down on it smartly at three equidistant points around the nut. I have never seen a white man grow very skillful at this, but it can be done.

The amazing thing about this difficulty of getting into a coconut is that all through the South Pacific, wherever there are coconut palms, there is a crab *(Birgus latro)* that not only eats coconuts in the raw but lives largely, if not entirely, on them. Exactly how the crab does this I do not know, for I could never catch one precisely in the act, nor have I ever heard of anyone else having that luck. But when you come upon a crab in the jungle and frighten him away from the nut you find that the

The Coconut Crab has claws of great size and enormous strength which can nip off a finger as easily as a twig. (Photograph by Lionel T. Berry-hill)

tough husk is rasped away as neatly as if with a file.

Always the crab attacks the husk at the end where the three soft spots of the "monkey-face" of the nut underneath will be found. Out of many dozen crab-eaten nuts examined I have never seen a husk which had been attacked even in a preliminary way from the wrong end. This is an adaptation of no mean value in itself. The coconut crab has claws of great size and enormous strength. A crab a foot long, a not unusual size, can snap off pieces of a mangrove stick the thickness of a broom handle about as fast as you care to feed it into his claws. But the smoothness of the rasped coconut husk argues against the claws being the instruments by which the nut is entered. Such crude and undelicate weapons would certainly tear and shred the husk, and this the crab never does. It is probable that the powerful claws are used mainly for defense and for snipping the nut from its stem on the tree—for, as we shall see, the coconut crab can pick its own fruit. The finished work looks as though it were done by the chewing mandibles and the nut, when finally reached, is apparently opened by prying with the sharply pointed second legs into the soft "eyes" of the nut.

This is not an occasional feat of this crab, but the way it makes its living; and it is said that when coconut crabs are deprived of coconuts they will starve to death before they will touch other food. So far as anyone knows this is the exclusive food of the crab in the South Pacific, although on Christmas Island in the Indian Ocean, where there are no coconuts, it eats other fruit. (A specimen brought from Bikini after the atomic bomb tests to the Steinhart Aquarium of the California Academy of Sciences staged a prolonged hunger strike, while anxious aquatic biologists set before it progressively everything in the Aquarium larder. Just short of starvation, it was feared, the crab accepted raw horse-heart, and is now thriving on that exclusive viand.)

Because of the refined diet of coconut the crab's flesh is so sweet and oily that the natives everywhere consider it a delicacy and seek its owner eagerly. To capture one is by no means simple. In the first place the crabs are fearless, and rightly so, for their crushing claws are sufficient protection against any normal natural enemy. When danger approaches they never turn tail and run; they always face up to it with their claws hanging down attentively protecting the tender abdomen. Any move toward one is countered by a lightning swift snip of a claw, and it can nip off a finger as quickly as a twig. They can be clubbed, speared, or stoned into insensibility, but this will spoil a good deal of the meat and a native is not one to ruin good meat—that is scarce in the islands. The natives prefer to catch them coming down trees.

For it is a fact that these crabs can climb as much as fifty or sixty feet up the slippery bole of a palm to the top where the nuts grow. A crab never attempts to eat nuts aloft—that would be

impossible; it snips them off so they will drop to the ground. But now the crab is faced with a problem. It is hard to shinny up a coconut tree, even harder to come down safely. On the trip up the heavy claws are carried in front out of the way and the climbing is done by the needle-sharp back legs, the tail helping out some in the manner of a brace. On the trip down the bulky claws are even more of a nuisance; because of them the only practical way to descend is tail first, and here the native takes sharp advantage of a weakness in the crab's armature—the tail is apparently not a very sensitive organ of touch.

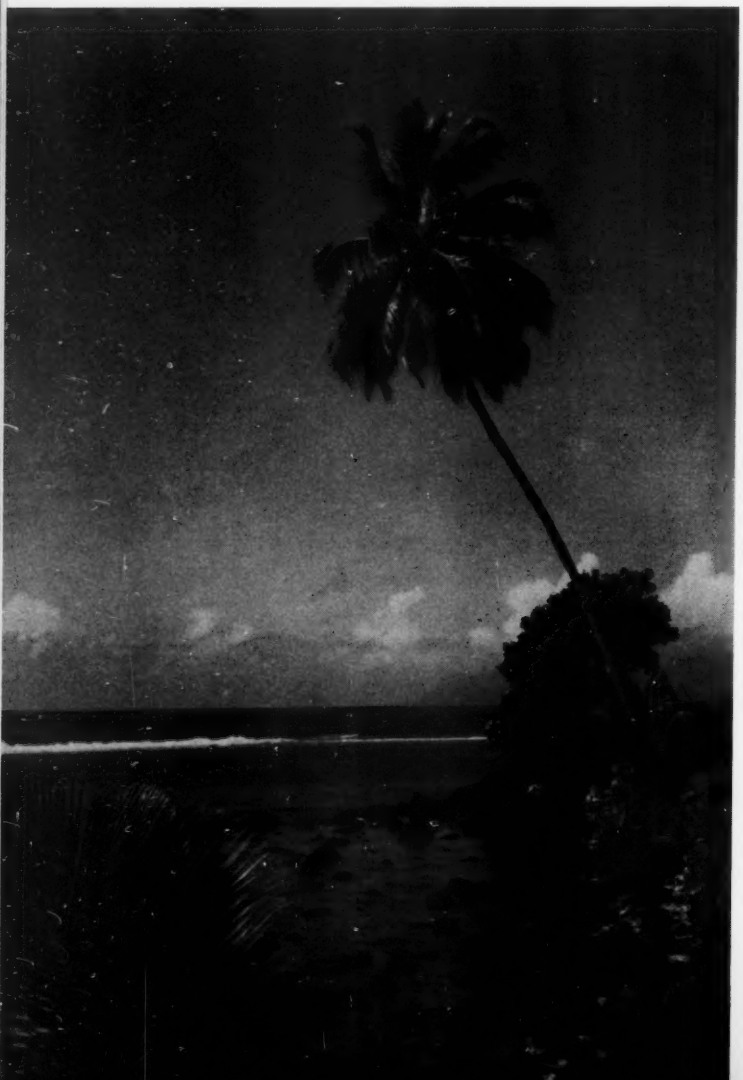
Having spotted a crab up a tree the native climbs ten or fifteen feet and wraps a rope around the trunk to such a thickness that a ledge is made. The crab, sooner or later, comes backing slowly down the tree, hits the rope, keeps right on coming, loses its footing and tumbles to the ground, the impact stunning or killing it. A judiciously placed rope will produce a stunned crab whose claws can be lashed shut and made harmless. The

The coconut palm is the "tree of life" both to crabs and men in the South Pacific islands. It provides food for coconut crabs, food and shelter for men. In the foreground, sections for a house "prefabricated" from palm fronds.

crab can then be safely tethered out alongside the shack and kept as a source of fresh meat until needed—a necessary economy in the South Seas where meat spoils so quickly it has to be cooked and eaten soon after the killing.

So far as I know coconut crabs are chiefly nocturnal. They are seldom seen by day, except during seasons of migration, even in areas where freshly gnawed nuts show them to be abundant. This habit in itself made them an utter nuisance to the troops during the war. A jungle by day is as quiet as you please, but at night it is so full of racket and noise you would scarcely believe it. A good share of this night noise in the island jungles is contributed by coconut crabs. They have little to fear and they make no effort to be quiet. They crawl along with all the stealth of a tank, rapping their claws on the underbrush, snapping twigs and branches, rasping on nuts, scuttling suddenly through the bushes. It is a fearful disturbance of the peace during normal times; when you are half expecting Japanese visitors it grows positively unnerving.

Coconuts on the tree are cased in a husk of the toughest fiber an inch or more thick, for they are built to resist the abrasive action of surf, coral, and rock.



Crabs are animals of the sea by origin, and most crabs spend the whole of their lives in salt water. Coconut crabs go ashore and live ashore, in the burrows of land crabs they have driven from home; but when it gets close to spawning time they as well as the land crabs head for salt water to lay their eggs—for only in the sea can their young develop safely.

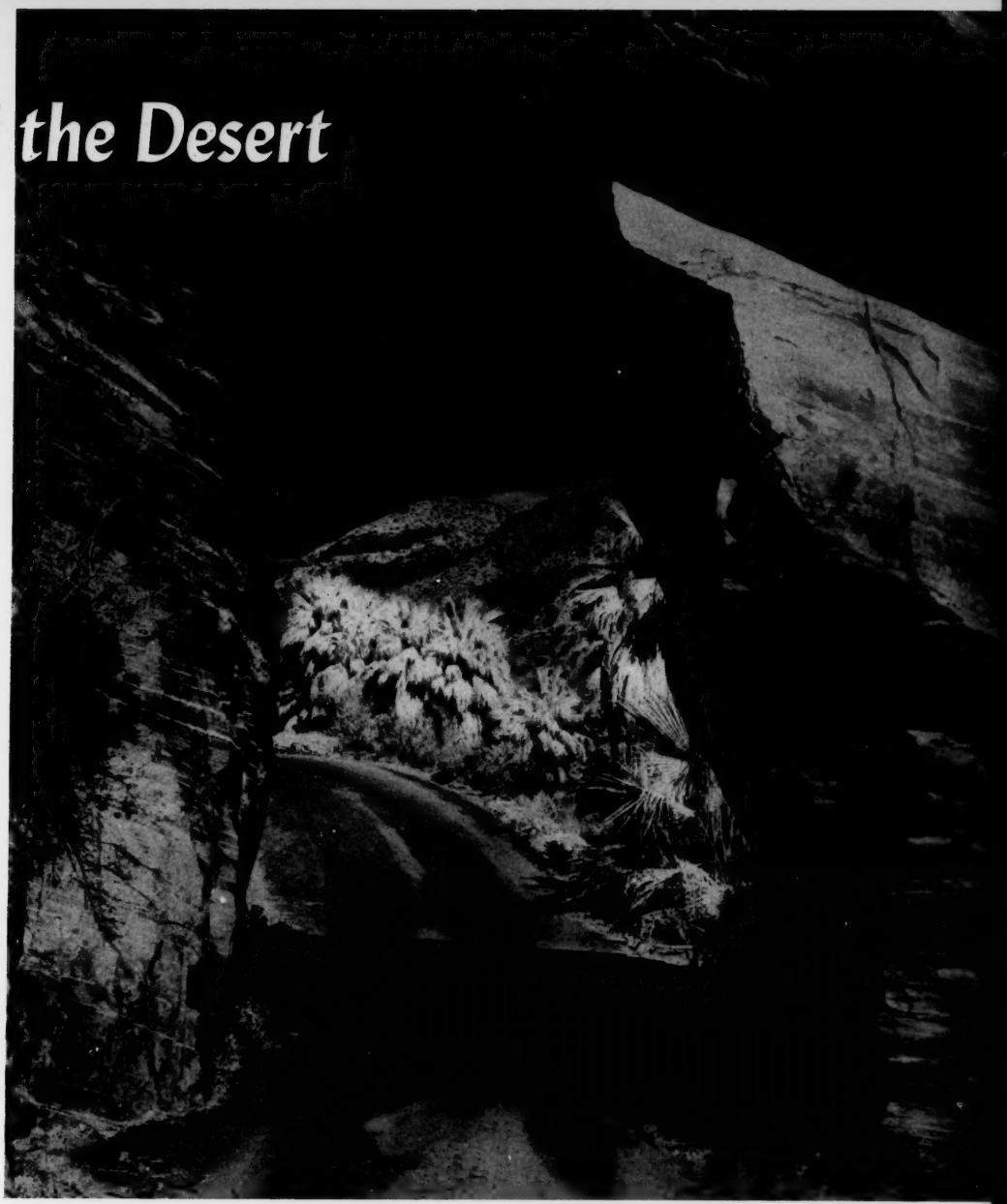
The landing at Munda, in the Solomons, coincided with one of these seaward crab migrations and here crabs and Americans met with mutual disgust and mistrust. GHQ decided to build the airstrip right across the migration trails of the crabs and this the bulldozers and power shovels did in jigtime. The crabs refused to recognize or to be intimidated by Americans and kept pouring out of the jungle toward the sea for six weeks. Soon the planes were coming in and taking off, smashing crabs on the strip by the dozens, and the airstrip at Munda took on an odor which was famous through the Solomons. As soon as the wheels of a plane stopped rolling the crabs would attack and nip futilely at the big tires of the enemy. The crabs never surrendered; they kept right on moving to the sea, and when they got through with their job there they came right on back across the now finished strip to the jungle.

Coconut crabs have little use for, and pay small attention to, the vagaries of mankind. They were here first and they will probably be here last—as long as the coconuts hold out. The natives had to be removed from Bikini and it is not yet safe after a year's time to let them go back. But when the surveyors of the bomb damage returned to the island last summer to have another look they found the coconut crabs abundant, hearty, and irritated to see them again.

Photographs on the front cover and on pages 5 and 6 are by courtesy of the Matson Navigation Company.

Edge of the Desert

VINSON BROWN



Palm Canyon cuts into the flank of the San Jacinto range at the edge of the Colorado Desert, California. (Photograph by Don Bleitz)

SOME TENS OF THOUSANDS of years ago, the paleontologists tell us, the desert moved north from Mexico into southern California, Arizona, and Nevada. It moved in a thousand creeping rills of sand, in a dry wind that sucked moisture from the air, in a blazing sun that glared red in a brazen sky. As the years became drier, the forests retreated to the edges of the few streams; grass came where forest had been. Then the rivers dried up and the last trees died so that their black and twisted skeletons lay in the sun. And it became too dry even for grass, so the mesquite and the cactus, the yucca and the pale quick wildflowers of the brief desert spring rolled northward in waves. The animals that had been used to moisture migrated gradually to new homes, and new forms of life crept up from the dry plains of Mexico, life adapted to the desert.

Of course, the desert did not spring into being suddenly, but moved its red tongue only through hundreds and thousands of years northward into

its new conquest. It is only today, with the coming of civilized man, that sudden and sometimes distressing changes have been thrust on the desert scene.

Commercialism and cars, resorts and advertising have spoiled some sections of the desert, but fortunately there are still wide areas where the nature seeker can go to find that queer and intriguing wildlife that imparts such age-old flavor to the southwest. And one great ally on the side of the naturalist and the wild is heat. When the intense heat of summer comes, the casual tourist and the soft resort seeker move to cooler climes.

In the summer of 1947 I went back to the desert to catch again the feeling of wonder and adventure that had been mine many years before in the land of sand and cactus. I came down from the fog banks and the green trees to the white sands, the raw glare of sun on rock, and the life that scurries for food most feverishly when darkness cools the furnace of the day. To begin with, perhaps I may be permitted a memory of that first exciting desert summer of several years ago.

I spent that summer on the edge of Palm Springs on the Colorado Desert. Palm Springs in summer was far different from the resort town of winter and spring. Gone were the myriads of visitors, gone the mobs of cars. The desert sun beamed sublimely and fervently over its own, and the few residents who remained to people the winter-thriving town spent most of their time out of sight in their homes. The surrounding low hills, the steep and rocky slopes of two mile-high Mt. San Jacinto to the west were free and open to the naturalist.

This does not mean that my friend, Ted Zschokke, and I were out at midday poking about among the rocks and cactus. Far from it! Even those animals most highly adapted to desert conditions do not care to face 135 to 165 degrees of heat in the open. No, surrounded by our cages of snakes and lizards in the shade of some palm and acacia trees, we would lie in our hammocks and pass a hose of cool running water back and forth, while we dozed, read, and talked through the time of great heat. But the evening, the night, and the early morning were our times of adventuring. In those hours of semi-coolness the creatures of rock and sand were also abroad, going about their business of food gathering and play.

Around our blazing lights at night giant beetles droned like miniature planes, moths came on ghostly wings, and crane flies bowed awkwardly in a clumsy dance. The vinegaroons, those queer, eight-legged devils of the desert night, raced at top speed in and out of the shadows to gather insect prey, their hairy pedipalps quivering with excitement. Big toads hopped up from our little pool to ply their rapid tongues, and brown, four-inch scorpions scuttled along the edges of darkness.

But you must get away from the houses and highways and go out to where you can't see wire fences any more to find the real desert life. Go in the evening time, for that is best of all, then watch and wait and listen. You will see the kangaroo rats come out of their holes under the mesquite bushes to leap, to run, to play tag, to fight great jumping fights high in the air with lashing feet. Or a small gray desert fox will be a sharp-eared shadow behind the moonlight-haloed knobs of the cholla cactus, now here, now there, then gone. And you will see, perhaps, a sidewinder, silent and

ABOVE: *Desert Kit Fox (Vulpes macrotis arsipus).*

RIGHT: *Desert Kangaroo Rat (Dipodomys deserti). (Photographs by Gayle Pickwell)*

California Horned Lizard (Phrynosoma coronatum). (Photograph by Gayle Pickwell)

deadly, working his incredibly intricate way over the sand. He seems to be going in one direction when actually he is going in another. This desert snake moves by lifting his body, swinging it across space, and then flowing with it into a new place on the sand.

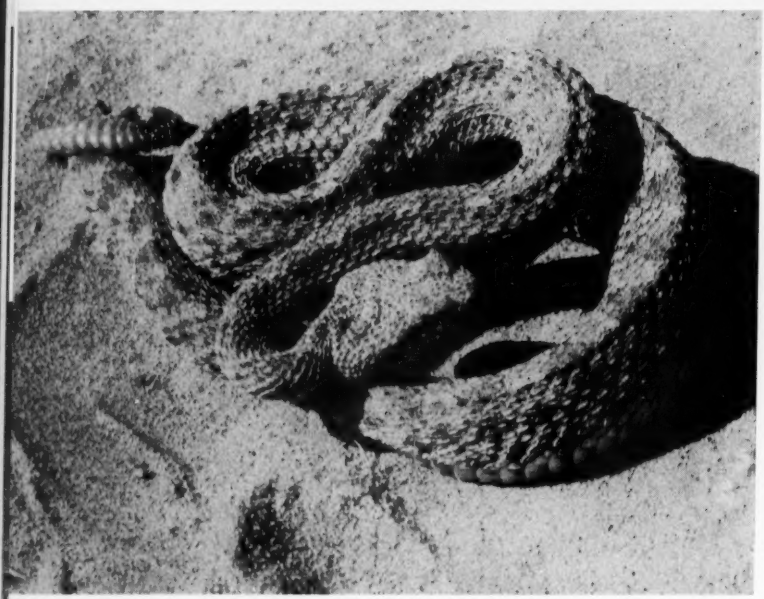
I sincerely regret now that in those earlier days I did not take more careful notes on what I saw. Now I know that whole vast and completely unknown fields await the eager explorer. Night time is when desert life is most active. Queer and interesting snakes such as the long-nosed snake, the shovel-nosed ground snake, and the leaf-nosed snake—to mention only a few—lead secret lives through the hours of darkness of which scarcely a word has been written.

Perhaps the "seeing eye" our soldiers used during the war, utilizing infra-red light to point out the enemy in the darkness, may be the tool needed for the study of night life. Certainly when Ted and I sat for an hour or more, still as waiting cats in the star-blazing darkness of a desert night, we would hear much movement of life. There would be little rustling noises under the mesquite bushes, squeaks, and other sounds that whispered through the stillness with the intent breath of living. Yet, if we turned on our flashlights or made the slightest noise, much of the night-magic vanished, and we would perhaps catch only the obsidian gleam of tiny eyes, as gray forms whisked down their holes and the night became suddenly lifeless.

It was on the nights of the full moon that our silent watching brought its best fruits. On those nights our delight was to watch the kangaroo rats, those long-tailed elves of the great sand wastes, at their play and fighting. What poise and balance! What grace and beauty! Out of their holes under the mesquite swarmed these little nocturnal people when our stillness made them think we were only gray rocks under the moon. What fun it must be to jump ten feet through the air!—to hurl oneself up into space and flick about with a twist of one's long tufted tail so as to turn at right angles and land in an unexpected place. And how those powerful long legs could kick! The beautiful fawn-colored fur would fly when two eager males met in kicking combat in midspace.

But soon, fighting forgotten, all would be feeding. Cheek pouches would be stuffed with mesquite seeds until cheeks bulged like hard balls. Then—*stamp-stamp!*—feet beating a warning on hard-packed sand would send the elf-creatures diving down their holes as great wings brushed by and a wide shadow moved over the ground, silent as death. One thin scream would penetrate the darkness. Then into the night the owl would bear the careless rat who had forgotten everything except to play and feed and fight.

Never to be forgotten were those wonder-filled nights, nor the days we swam in the deep pool of San Andreas Creek and followed the garter snakes into the underwater caves. Back we would go through green darkness to the hidden rooms of the great rock where all was delightfully cool in the midst of the surrounding furnace of the desert. But there was something about the desert itself a



UPPER: *Pacific Rattlesnake (Crotalus viridis oreganus) in the button stage.*

LOWER: *Sidewinder (Crotalus cerastes). The triangular head and narrow neck characterize all rattlesnakes, and the "horn" over the eye marks the sidewinders. (Photograph by Gayle Pickwell)*

timeless peace, a sense of comradeship with the ancient hot old earth, that has drawn me back to visit it and the creatures who dwell in dryness.

Yet, on my short trip to the desert in the summer of 1947 I was unfortunately more a "collecting naturalist" than a "watching" one. It was from necessity rather than choice. Time was short and I needed specimens for my research. I went to Cabazon on the main Yuma-Los Angeles highway, then up Millard Creek Canyon into the foothills of the San Bernardino Mountains to the north. It was June, but at the 4,000-foot altitude where I camped frost glittered on the grasses of the dawn.

The high desert canyon was a paradise for lizards, while along the cottonwood-shaded creek frogs dove through sandy shallows. Here in the hills the greater coolness compared to the true desert two thousand feet below made all the lizards lovers of the sun. I had a noose at the end of a fishing rod and with it I collected western fence lizards *(Sceloporus occidentalis)*, little gray-backed utas *(Uta stansburiana)* with pretty brown shoulder patches, and California horned lizards *(Phrynosoma coronatum)*. These creatures basked on the great gray granite boulders and were often easy to noose if one crept up on them quietly. But the big tessellated race runners or whip-tailed lizards *(Cnemidophorus tessellatus)* were a different matter. Away they rushed through the brush, like racing stallions. Or, when one crept up on them silently, they had an annoying habit of moving ahead in short jerks, always just far enough to keep beyond the reach of the noose. Regretfully I used small shot from my twenty-two to get those long narrow greyhounds of the chaparral. Wounded, they snapped fiercely at my hands when I grabbed them, and it was some relief to get them safely into a can with a cloth soaked in chloroform.

In the high canyon dwelt a plentiful population of the Pacific rattlesnake *(Crotalus viridis oreganus)*. These snakes were a sign of the farthest desert-ward extension of the California Biotic Province. One big and fierce-looking black fellow I chased under a flat stone. When I overturned the stone, three of them were rattling and striking at me all at once! For a time there was considerable excitement until by the use of the noose, snake bags, and chloroform all were brought under control.

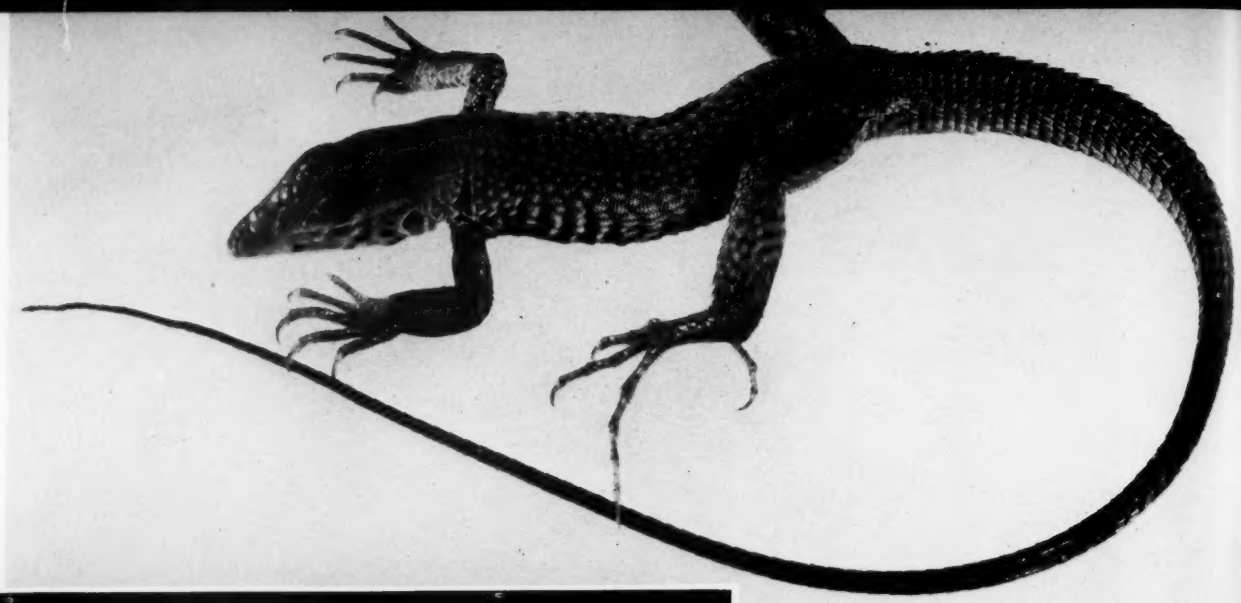
Cabazon and Millard Canyon are in San Gorgonio Pass, the pass leading from the desert

Jungle in the desert—Andreas Canyon. In the middle distance, Washington fan palms. In left foreground, honey mesquite bearing a mass of mistletoe. This is ideal hunting ground for many reptiles and other desert creatures. (Photograph by Gayle Pickwell)

to the more humid valleys of the coast. It is in this pass that Dr. Laurence M. Klauber of San Diego, a leading authority on western reptiles, had told me to look particularly for the line that divides the desert reptiles from those of the coast. Millard Canyon seemed to be more coast-like than desert in its fauna. Besides the Pacific rattlesnakes, I saw and almost captured a specimen that was definitely a mountain garter snake *(Thamnophis ordinoides* subspecies), flashing brilliant yellow and black in the green grass near an irrigation ditch. This fast-moving snake is native to the mountains and shuns the desert.

But when I went on a trip lower down into the desert country, collecting in Cottonwood Canyon (five miles east of Millard Canyon), and Whitewater Canyon (five miles still farther east), there was a distinct change to desert species. In Cottonwood Canyon the brush by the spring suddenly rattled with the scrambling rush of giant desert spiny lizards *(Sceloporus magister).* Armored like dinosaurs, thick bodied and powerful, they crashed through the branches. A captured specimen nearly tore the skin of my hands in its savage struggles to escape.

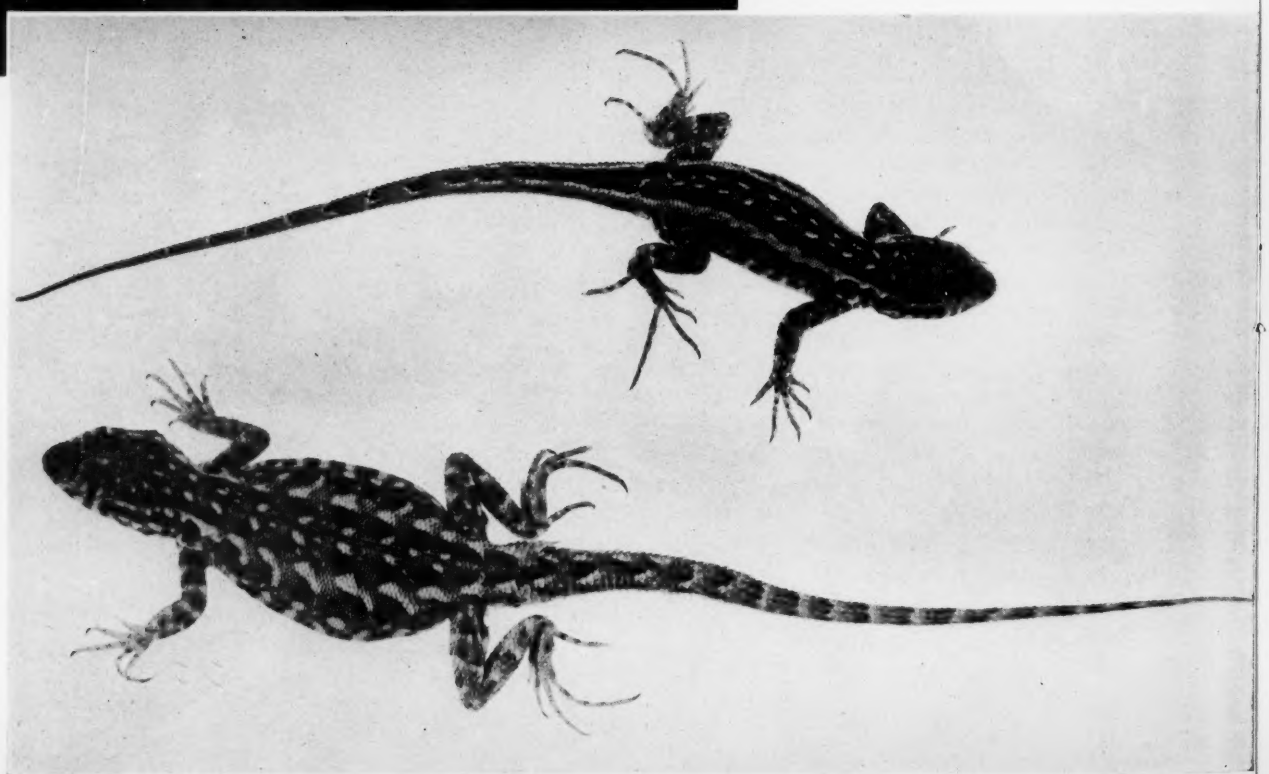
My best sign of the desert in Whitewater Canyon was the fishhook marks of sidewinders *(Crotalus cerastes)* in the sands. But the blazing sun had driven these small but nonetheless deadly rattlesnakes under cover. Higher up in a side canyon of Whitewater Creek I surprised a four-foot, brown diamond-marked rattler which slipped quickly back into the rock before I could grab him, rattling sullenly and defiantly when I poked



ABOVE: *California Whip-tailed Lizard (Cnemidophorus tessellatus).*

LEFT: *Desert Spiny Lizard (Sceloporus magister).*

BELOW: *Brown-shouldered Lizards (Uta stansburiana).*
(Photographs by Gayle Pickwell)



at him with my fishing pole. At a quick glance I might have taken this ugly and deadly creature for a desert diamond rattlesnake and wondered, on second thought, what he was doing so far from his supposed range in the lower reaches of the Colorado Desert to the southeast. As it was I had to put him down as not positively identified in the field. There are many species and subspecies of the venomous genus *Crotalus,* each with its more or less well-defined geographic limits.

It is interesting to know where lies the line that divides the snakes and lizards of the desert from those of the California coast, for it is very sharp. Suddenly, almost, you seem to move from one world into another. Heat and dryness have drawn the line along the edges of the San Bernardino and San Jacinto Mountains almost as plainly as a pencil mark on a map. Here the desert species sweep up against the ramparts of the hills, and, for the scientist, there is much interesting mixing of coastal and desert races. Here is marked the ancient story of the northward marching desert heat in scale and claw and colors blending in camouflage with the sand.

When I go southward again, some buried tree trunk, perhaps, or a fossil of a fern in a land too hot for ferns, will tell me of that aeon-long war between the dryness and the damp. But what will call me most is the thought of lying still, again, in the silence of the desert night and watching, as I did in those happy times before, for the secrets of its weird life.

BOOKS ABOUT WESTERN REPTILES:

Amphibians and Reptiles of the Pacific States, by Gayle Pickwell. Stanford University Press. 1947. (A well-illustrated descriptive handbook for students and the general public.)

The Reptiles of Western North America, by John Van Denburgh. Volume I: Lizards. Volume II: Snakes and Turtles. California Academy of Sciences, 1922. (A technical monograph of particular usefulness for more advanced students and specialists.)

The Desert Crested Lizard (Dipsosaurus dorsalis dorsalis) belongs to the lower levels of the Colorado and Mohave deserts and is not found on the upper slopes or beyond the "edge of the desert." According to Dr. C. Hart Merriam, Dr. Gayle Pickwell, and other authorities, these lizards live almost entirely on leaves and flowers, getting both food and water from this vegetable source. (Photograph by Don Bleitz)

GRACE IRENE CROWE

Swivel Chair Birding

SWIVEL CHAIR BIRDING is a specialized type of armchair birding. The many brief but nonetheless thrilling observations of birds which one can make during his workday routine may all be grouped under this heading. We might even claim that swivel chair birding is the busy person's method, while armchair birding is the lazy one's. At any rate, to glance up from one's work and catch an unexpected glimpse of a bird at the window brings great delight.

The California Academy of Sciences in Golden Gate Park, San Francisco, is ideally located for bird study. Furthermore, it seems that the Academy's Department of Birds and Mammals has the ideal vantage point. One side of the departmental quarters faces the Shakespeare Garden and rhododendron dell; the other side overlooks the 70 by 133-foot whale court with its generous planting of native and exotic shrubs and trees. Within this three-sided enclosure the mounted skeleton of an 86-foot sulphur-bottom whale and the skulls of three other whales are protected from the elements by an open-sided, shingle-roofed shed. From our windows on the southwest side of the court we may look out upon the parade of bird life through the park. Many of the birds that come to our windows live near the building, some even within the court. Others are migrants or "pilgrims," or casual passers-by. Some work about in the trees. Others merely cast their silhouettes across our patch of sky. But each has its own special charm, and provides relaxation for tired eyes.

One morning during a telephone conversation I was scanning the trunk of the New Zealand beech tree just outside the window when an unfamiliar bump on one of the branches opened its lemon colored eyes and blinked drowsily in the sunlight. The excited squeal that I let go unstifled, and the incoherent explanation which followed, seemed to be not nearly so disturbing to the screech owl as to the person on the other end of the line.

The screech owl had many spectators that day as it perched about ten feet away from the window. Whenever we tapped on the glass the owl obligingly opened its eyes and candidly returned our stares. Once, when an airplane passed across the sky, the screech owl appeared to follow the plane with its eyes, turning its head slowly until the plane was out of sight. During the interval between August 13 and November 8, 1943, the owl returned six times to its chosen spot outside the window. Possibly the screech owl lived in the courtyard, perhaps even in the whale shed, but this was never confirmed.

Hummingbirds are most conspicuous among the birds of the whale court. Anna hummingbirds, with their flashing crimson gorgets, are with us all year round. During February the flame-throated Allen hummingbirds return to Golden Gate Park after their winter sojourn to the south as far, perhaps, as northwestern Mexico. There is great excitement in the hummingbird world when the Allens return. The Annas, having had the park to themselves for the winter, are forcefully made aware of the newcomers' territorial claims.

The courtyard seems a favorite site for the nuptial display of both species of hummingbird. In December the Anna may be seen plummeting down over the wisteria vine with terrific speed, and—just at the instant one is sure the bird will be dashed against the roof of the whale shed, one hears, instead, a shrill sound as the hummer puts on the brakes then veers upward into the clear. In late February or early March an Allen hummingbird may be seen describing a wide arc as it swings, like a jeweled pendulum, back and forth over the spot where its mate is perched.

At the beginning of the nesting season the female hummers, both Anna and Allen, shuttle back and forth, describing scallops around the edge of the whale shed as they tweak off bits of cobweb for their nests or, perhaps, snatch insects from the spider's lair. Both species of hummer have been known to nest and rear their families in the court or nearby. Dr. Robert T. Orr *(Condor, 41:* 17-24, 1939) studied the behavior of the Allen hummingbird at a nest placed within three feet of one of the windows on the southwest side of the building.

In late September, after the Allen hummers have gone south, the Annas appear to sense their freedom, fearlessly invading the territories the Allens forbade them. One grows more conscious of the Anna hummingbirds, of the individuals at least, in the winter when the males may readily be observed at their lookout posts, squeaking intermittently. A male Anna hummer has maintained its

territory from the topmost branch of the white birch tree for three consecutive years. I often wonder where it goes to spend the night.

A nestful of 18-day-old Allen Hummingbirds in Golden Gate Park, San Francisco. (Photograph by Robert T. Orr and Frank Lee Rogers)

Of all the birds living in the court, the chestnut-backed chickadees seem to have priority for they repeatedly rear their families in cavities in the jaw of the whale skeleton. In 1931 Mr. Joseph Mailliard *(Condor 33:* 220) described this occurrence. The tradition still prevails!

Like the chickadees, the Bewick wrens find the dark foramina of the whale skulls desirable places for nesting. In the spring of 1937 Dr. Robert T. Orr observed the wrens building a nest in the fin-backed whale skull. On April 8, the following year, Dr. Orr noted that the wrens had begun to build in the skull of the sulphur-bottom whale, but were driven away by the chickadees. The wrens apparently were not too discouraged over losing the battle; they repeatedly nest in the vicinity of the whale court, pouring out a confusing medley of songs during most of the year.

The bush-tits constructed their gray, pouch-shaped nest in a bride tree *(Hoheria)* just outside the window on the southwest side of the building. When first noted, the parents were making frequent trips to their nest which was suspended from a branch thirty feet above the ground. The sides and bottom of the pouch bulged and twitched with the movement of its tiny inhabitants. We were not privileged to see the young fledged. It may be they have joined the flock that flits unhurriedly from branch to branch in the New Zealand beech tree.

The magnolia tree near the library window was the robins' choice for their nesting. It was pleasant indeed to look up from rows and rows of technical books in time to see the mother robin settling herself gently over three pale blue eggs.

The purple finches brought their three offspring to the black walnut tree on four consecutive mornings last spring. The young birds chattered noisily as they sunned themselves, and, with fluffed out feathers and fluttering wings, begged for food whenever the parents approached.

A female Oregon junco scurried into a fuchsia bush at the southeast side of the Aquarium instead of flitting away as usual with a careless flash of white outer tail feathers. Her reluctance to leave the spot at my approach aroused suspicion. Closer inspection revealed her awkward offspring clutching a crosspiece of a morning-glory-covered lattice, looking uncertain and very naïve as a gentle breeze toyed with the tufts of soft down on its head. The fledgling had ventured only six inches from the nest which was wedged snugly into the four-inch space between the building and the lattice, three feet above the ground.

On June 29, 1944, the white-crowned sparrows were observed with their youngster in the court. The fledgling was perched on a spray of honey flower *(Melianthus)* about six feet from the ground. Whenever the adults were near, the young bird fluttered its wings and crouched down as the parents transferred food to its waiting mouth. The youngster wiped the sides of its yellow-rimmed bill daintily on the branch, then busied itself with hopping along the stem, pecking curiously at the leaves until one of the adults returned with more food. It seemed quite independent when they

were gone, but pitifully dependent when they had anything to offer.

The spotted towhee's vigorous scratching in the dead leaves beneath the shrubs is a frequent sound. He comes often and regularly, and, while he appears a resident, his family has not been observed in the courtyard.

California quail head the list of birds that visit the whale court regularly. At four-thirty on a winter afternoon, one may hear the ringing voice of the sentinel quail as he struts along the ridgepole of the whale shed, calling *ca-crook-cra!* There is an answering chorus of *tsk-tsk-tsk-tsk!* notes as the flock rushes into the courtyard, like plume-helmeted soldiers who have just been given the at-ease signal. There were at least forty individuals in the group that gathered on October 11, 1946, to scratch in the gravel around the incinerator where waste birdseed had fallen. As twilight settled over the landscape, the shadowy forms of roosting birds were clumped together in the now leafless walnut tree.

The black phoebe may be seen, especially in the winter time, when it perches on the coping at the corner of the building, and sallies out frequently in search of insects. Occasionally the phoebe perches in the New Zealand beech tree while gulping down a large insect, or appears at the window corner to snatch a struggling insect from the web of the golden orb weaver.

Visitors throng the courtyard, some lingering in their daily rounds, others, perhaps, stopping over in migration. After a rain when the air was pungently fresh and the leaves still dripping, on October 30, 1944, six different species were noted

California Quail head the list of birds that regularly visit the Whale Court, Golden Gate Park, San Francisco. (Photograph by Frank Lee Rogers)

Allen Hummingbird brooding. Nest is in a gum tree next to North American Hall, Golden Gate Park, San Francisco. (Photograph by Robert T. Orr and Frank Lee Rogers)

within three minutes. A hermit thrush savored the grape-sized fruit of the persimmon tree *(Diospyros)*, then flew to the New Zealand beech tree where a Townsend warbler and a Hutton vireo were foraging. A few seconds later a white-crowned sparrow joined the group. Under the shrubs below, the spotted towhee was scratching industriously. The vireo flitted away, the white-crowned sparrow moved over to the wisteria vine on the whale shed, an Audubon warbler came then to the New Zealand beech and drove the thrush and Townsend warbler away. The Audubon warbler's victory was short-lived for the tree was usurped a moment later by five Oregon juncos.

In winter the red-breasted sapsucker, flashing red and black, flies across the court. The varied

Female Allen Hummingbird feeding her 12-day-old nestlings, Golden Gate Park, San Francisco. (Photograph by Robert T. Orr and Frank Lee Rogers)

The Whale Court, North American Hall, California Academy of Sciences, Golden Gate Park, San Francisco. Skeleton of the Sulphur-bottom Whale. (Photograph by Frank Lee Rogers)

thrush pauses soberly in the dense foliage as it waits for a rainstorm to spend itself. The fox sparrow breaks the purple skin of the persimmon fruits with its stout bill, and eats greedily of the orange pulp. A ruby-crowned kinglet peers under a leaf in search of insects. More rarely a golden-crowned kinglet forages outside the window. Ever on the alert, the kinglets weave in and out among the outer branches of the New Zealand beech trees, seeming to shrug their shoulders as they flick their wings restlessly.

In the spring, a western flycatcher darts out to intercept an insect. The melodious notes of the russet-backed thrush spiral upward. In the summer the spritely yellow warbler, the pileolated warbler with his jaunty black velvet cap, and the more somber lutescent warbler are frequent visitors.

The green-backed goldfinch, a resident here, is seen in the courtyard when a stray dandelion or sow thistle that has escaped the gardener's sharp eye begins to show hoary white, seed-laden flower heads.

Most any time of year a dowdy little English sparrow or her more dapper spouse may be seen in the courtyard. In the evening the loud *cheep-cheep!* notes sound as the flock beds down in the ivy vines on the building.

Then there are the birds that announce their presence with their call notes, but which we have not seen in the courtyard. To this group belongs the red-shafted flicker whose *chuck-chuck-chuck!* comes frequently from the grove of conifers. A harsh *spick!* note tells of a downy woodpecker in the neighborhood. The raucous call of the California jay rises from the cypress tree on the southeast side of African Hall. The nasal *yank-yank!* of the red-breasted nuthatch, the deeper note of the slender-billed nuthatch, and the thin call of the creeper have also been recorded. The oft-repeated song of the linnet and the unmistakable *McDeever!* of the olive-sided flycatcher are familiar sounds. The chipping sparrow with its barrage of notes, the plaintive golden-crowned sparrow calling *oh-dear-me!* and the song sparrow who has staked a claim and intends to keep it by announcing ownership periodically, may also be heard.

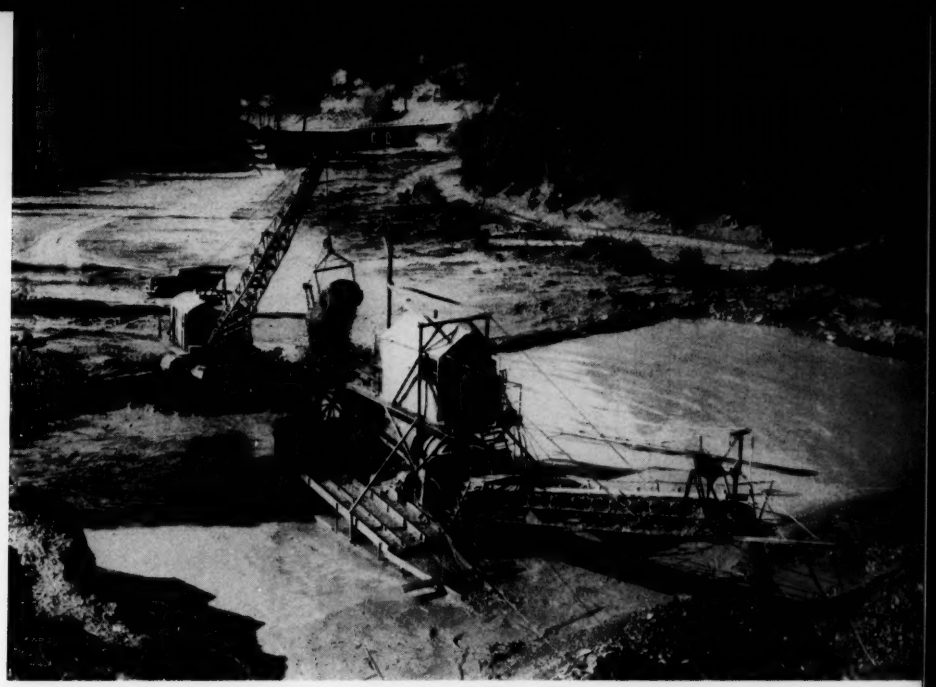
The casual passers-by, who show no real interest in the courtyard or its inhabitants, include the mallards and pintails flying directly to Stow Lake, the turkey vulture soaring listlessly, the red-tailed and sharp-shinned hawks as they glide overhead, the Cooper hawk sulking among the shrubs at the back of the Aquarium, the sparrow hawk hovering and calling harshly from the conifers, a killdeer with sickle-shaped wings hastening to the ball diamond where it will feed, robin-like, on the lawn, and the four kinds of gulls—California, glaucous-winged, ring-billed, and western – as they circle and wheel.

The kingfisher gives a loud rattling cry as he hurries past in the direction of Quarry Lake. Three ravens, uttering hoarse croaks, fly ominously by. Occasional flocks of cedar waxwings pass, lisping. Flashes of yellow wing bars accompanied by thin little call notes betray the pine siskins on their way to the conifer grove. With nesting duties over, flocks of Brewer blackbirds pass overhead on their way to forage on the baseball diamond.

Birds-out-of-habitat include the yellow-throat that perched, waiting out a storm, on a spray of toyon berries in the wildflower exhibit in our building's open lobby. There is record also of a clapper rail (R. T. Orr, *Condor, 41:* 151-152, 1939) having come to the courtyard, driven by some circumstance from its marshy habitat. And on April 2, 1945, a black rail, probably migrant, was found where it had been hit by an automobile on the road behind the building (R. T. Orr, *Condor, 49:* 41, 1947).

Joseph Mailliard in *The Birds of Golden Gate Park, San Francisco* records a total of 110 species that occur naturally in this 1013-acre tract of city park with its varied habitats, including lakes, marshes, and plantings of trees, bushes, and lawns. Of this number fifty-nine species of birds have been seen in the restricted area of the whale court or heard in the vicinity of the building. This rich bird population is even more remarkable when one considers the fact that seventy-odd years ago much of the present park area was rolling sand dunes, dotted, no doubt, with clumps of lupine and inhabited by burrowing owls. Through man's interference with nature, some species have suffered the loss of their habitat as the area has been brought under cultivation but others have gained new ground. While it may seem strange to see one of our native birds feeding on a plant from New Zealand, raising its young in the foramen of a whale's jawbone, and seeking shelter in a tree from China, there's evidence here of the adaptability of an avian species.

"Of what profit will it be to gain a few more pounds of gold if we destroy our own land?"



Floating dragline dredges operating on Weaver Creek, Trinity National Forest. (Photograph courtesy U. S. Forest Service)

JOEL HEDGPETH

Gold, Men and Fish

DURING THOSE CURIOUS DAYS when gold was not a medium of exchange, but was nevertheless purchased by the government at fancy prices, the old mining fields of the California foothills took a new lease on life. On the gravel bars of '49, long since considered exhausted, old men and college boys dug into the ground for a few grains of gold, which they redeemed at the nearest country store for coffee, beans and bacon.

Along the American, the Yuba and Feather rivers they worked in the blazing summer sun, shifting piles of boulders, digging pits into the bars and cutting trenches across promising locations. It was hard work, this moving gravel into new piles, carrying it in buckets to sluice boxes by the river's edge and panning out the residue for the little specks of color. A skilled sniper, the man who works abandoned claims, might make three or four dollars a day in this manner, but most of the miners of this latter day rush made far less. A flake half the size of a little fingernail was a strike, and few of the younger miners had ever seen a real nugget.

The college boys left the streams toward the end of summer to return to their classes. If they had been lucky or exceptionally industrious they had made enough for part of their school expenses. If nothing else, they had had a summer in the open. The old men stayed on in their makeshift cabins until the rivers began to rise from the autumn rains. Where they came from and where they went

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"GOLD, MEN AND FISH" appeared in *The Land*, Summer 1946 (Vol V, No. 2, pp. 202-206). It relates so directly to the current controversy over mining pollution of the Klamath River and other western streams that PD obtained permission from Joel Hedgpeth and from *The Land* to reprint the article here. The fight to keep our rivers clean has been long and bitter and it is still in progress. To date no really adequate anti-pollution legislation has been passed, on either the state or the national level. The May-June issue of PD will carry an editorial on the general problem of pollution and on current legislation which would prohibit using rivers as gutters for silt, sewage, and industrial wastes. **A.S.L.**

after they could no longer dig for the last bits of gold in the hills, no one seemed to know or care. Some of them spent their winters in shanty towns and jungles near the valley towns, others disappeared into the same mysterious nowhere from whence they had come. A few began their mining days in the raw fields of Alaska forty years ago, and they will die in their little shacks hidden in the gulches of the Sierra foothills. Now and then one of them is found dead in a city skid-road district. Perhaps it is as good a life as selling groceries, repairing automobiles, or preaching sermons. Who can say that they have failed in life if they are not unhappier than the rest of us?

Yet they were party to a strange, unnatural thing. Gold is now little more than a symbol in the minds of financiers, to be buried in the vaults of Fort Knox and manipulated on paper. For all the practical difference it made, the miners might just as well have been paid for laying out patterns of white quartz boulders along the paths to their cabins. As the price of gold rose to nearly fantastic heights, a more serious type of mining was resumed in the low paying fields, and a new devastation was visited on the land.

This was dredging, that last resort for mining deep bars and poor fields. Floating in the middle of a pond dug into the stream bed, with a bucket line gouging into the gravel for every last grain of gold, the dredge casts huge piles of rejected stones from the end of a long beam. Then it moves on to another pond until the entire stream bed is nothing but a wilderness of gravel piles. The first dredges worked over the ancient river beds in the Sacramento Valley sixty years ago, but the crescent shaped gravel heaps they left behind them might have been piled up only yesterday. They are raw, barren hills of gravel on which nothing can grow and among which the life blood of rivers is lost in blind trickles. There is nothing else done by man which leaves such an irreparable scar on the land unless it be the slag heap of a coal mine. A logged out forest will grow again in time, and shrubs will cover the gashed out mountain sides where the hydraulic monitors ate into them, but only the timeless forces of geology will build soil over these man made hills of boulders.

As the new price of gold brought the dredges creeping into the little streams, ruining them for our time and our children's time, old hydraulic diggings were also reopened beneath the pitiless force of the monitors. This latter method of mining nearly ruined the entire valley of the Sacramento fifty years ago when huge crests of gravel filled the rivers and moved slowly downstream toward the farm lands. The three foot tide of the Sacramento retreated down to the delta before the advance of the mining debris. This type of mining had been outlawed, but the increased price of gold made heroic measures economically feasible, at least in the minds of engineers and politicians.

A series of dams to hold the debris back in the rivers was to be the answer to the state mining laws. Two of these dams have been built in recent years, another was built twenty years ago. The dams on the lower Yuba and the North Fork of the American are high graceful structures, which will be left across the rivers as retaining walls for the masses of mud and gravel torn out of the hills by the hydraulic monsters. While waiting to be filled with mud, their impounded water turns no dynamos and waters no fields. Nor do they seem to be very satisfactory as settling basins: the overflow from the American River dam was so muddy that

Hydraulic mining. Monitor at work near the highway to Downieville, Tahoe National Forest. (Photograph courtesy U.S. Forest Service)

an injunction had to be filed against mining above the dam in order to protect the irrigated fields.

When the first of these dams was being built, at Bullards Bar on the North Fork of the Yuba River during the years 1921-24, so many salmon died below the rising dam that they had to be carted away and disposed of. This massacre of a salmon run received no publicity, and few outside the district are familiar with the facts, but certainly the engineers in charge were aware that the Bullards Bar dam had blocked some fish. Yet they made no effort to investigate the possible effects of the numerous dams they planned to build until 1938, when the construction of dams in more accessible parts of the mountains aroused a certain amount of protest and curiosity.

To those whose only conception of wealth is the metal dug out of the earth, these dams are a good thing, and they hope to see them in every gold-bearing stream in the country. A stream which is nothing more than a river of muck, its banks and stones covered with a thick slimy coating of colloidal silt, means nothing to a miner.

Objections of naturalists to this destruction of streams, and legislative restrictions for their protection, are considered mere annoyances. Laws requiring settling basins for mine tailings at the scene of operations are ignored whenever possible. Even the naturalists have admitted that there are hardly any fish left in the rivers, so why all the fuss about them? A miner has a constitutional right to recover the gold, and has a hard enough time doing it without interference by sentimentalists and the farmers down in the valley. If the farmers don't want the mud they should pay for the structures necessary to hold it back. Mining is expensive enough already without such added expense. So their arguments go. The use of the word "recover" is significant. Gold is not found in the earth, it is already part of the nation's wealth, and mining is simply the process of returning it to circulation. That it no longer circulates as money disturbs them not in the least. They do not know that California has outgrown its days of gold, and they neither realize nor care that the devastation they wreak upon an already battered country is not worth all the gold that is left in the hills.

No one who has not seen the mining country can realize the hideous mutilation of the countryside caused by the dredges, the hydraulic monitors, and the stamp mills which dump gray sludge into the streams. Some of the effects of hydraulic mining seem fantastic even to engineers who have not been on the ground, but many of the photographs taken thirty years ago for a detailed report

"Earthworms"—result of gold dredging—from the air, Eldorado County, California. Large areas in the Sacramento Valley have thus been turned to wasteland. (Photograph courtesy U. S. Forest Service)

of the damage can be retaken today, so slight has been the effect of natural forces on the gravel piles and old workings in that time.

There are piles of gravel defacing meadows and valleys which might have been more profitably left to livestock grazing. Miles of dirty yellow rivers and dense clouds of steel gray cyanide tailings pouring into once clear trout streams are other visible effects of mining. After several years, a stream may run clear again and the fish may work down from the high country above the mining district or upstream from the river, if there are no dams. But the construction of a dam, especially a high debris dam designed only for the purpose of holding mud, means an end to any hope of restoring a river.

While mining is in progress, the silt and other debris is a serious menace to the welfare of the fish in the stream. Not only does it carpet the gravel beds with mud and make spawning difficult for the fish, it also destroys the stream insects which are the food supply of the fish. The controversy between mining interests and biologists concerning the effects of this silt on fish life has been

a lively one. It has not been improved by spokesmen of the mining interests, if we are to take the *California Mining Journal* as a typical example. That hard-rock magazine, whose gaudy orange cover is possibly supposed to symbolize the gold which is its chief concern, would delight the most rugged individualist and prophet of free enterprise.

Unfortunately it was the publication of a paper by a noted salmon authority, the late Dr. Henry B. Ward, which gave the *Mining Journal* its strongest support. Dr. Ward's observations, carried out on the Rogue River in Oregon, were general and superficial and not strictly applicable to any other river but the Rogue, where the bulk of mining silt evidently entered the stream below the reaches in which the salmon spawned. But more unfortunate than these observations was the appendix of this paper, a report on an experiment by L. E. Griffen of Reed College, Portland. In this experiment, young fish were placed in clear and silted hatchery troughs. Reinforced by an imposing tabulation of results, this experiment appears to prove that silted water was actually beneficial to young trout and salmon. Of fifty cutthroat trout fingerlings placed in the muddy tank, twenty-eight survived after twenty days, whereas only four out of forty fish in the clear water were alive at the end of the experimental period. Later the experiment was repeated with 150 small salmon. Sixty-five of the seventy-five fish placed in silted water were alive after twenty-nine days, but only twenty-seven survived in the clear water tank.

Ignoring L. E. Griffen's qualified conclusion, the editor of the *Mining Journal,* in his October 1938 issue, devoted an entire page to this experiment. It demonstrated, he crowed triumphantly, that "young fish thrive on mud," and he further concluded that the turbidity restrictions in mining streams should be relaxed on the basis of this "evidence." Perhaps this is a minor example of the harm that can be done by loose interpretation of data, but it is typical.

When the daily table of losses in this experiment is examined more closely, we discover that most of the losses to fish in the clear water occurred in the first four days and that about 40 per cent of these early losses were due to such causes as "killed by the pump," and "leaped over the side of the tank." In both experiments, the mortalities were abnormally high for both clear and muddy troughs. Evidently the fish were frightened into jumping out of the clear water, and some unknown factor affected the entire experiment. Hence it cannot be said to have proved anything, either for or against silted water.

At the time this controversy was in full flower, during the summer and autumn months of 1938, the U. S. Engineers conducted a survey of the aquatic life of the American and Yuba river drainages to determine what the effect of their debris dams on the fish life of the rivers might be. The long years of mining, of unscreened diversion ditches and dams without fishladders had done their work well: only a few hundred salmon could be found in the rivers, and the streams were populated with useless native minnows, some of them more than a foot long. Extensive reaches of creeks and rivers were virtually aquatic deserts, carpeted with thick beds of fine silt or clogged with rubble.

The report of this investigation did not impress the editor of the *California Mining Journal,* although he devoted a scornful page of his December 1939 number to it. There were no fish left in the rivers, so there was really no reason to fuss over a little mud, and besides, the value of the gold which would be recovered was far greater than published estimates.

But that was not the point. It cannot be reiterated too often that it is possible to restore fish to an undammed river, or enable it to restore itself, but a stream cluttered with dams and mining debris is beyond hope of redemption. Once taken out, the gold cannot be renewed, but a good population of trout and salmon can be a perpetual source of food and recreation whose value will in the long run exceed the wildest estimates of the remaining gold.

During the war, gold was not considered essential to the nation's welfare, and mining was suspended in many regions. If we could get along without gold in wartime, when we increased the drain on our forests, our oil wells and our fisheries in the name of national peril, we do not need it in peacetime. Whatever use we may make of gold in the future, the reopening of these submarginal mines cannot be justified by any sane sense of values. Of what profit will it be to gain a few more pounds of gold, or the whole world, for that matter, if we destroy our own land? Turning the streams into barren wastes and piling stones on the fields is a strange way to increase our national wealth.

BORYS MALKIN

Mexican Experiment

LONDON, *November 1947*

DEAR DON: You must forgive me the delay in sending my notes on Mexico. Upon my arrival here I found myself preoccupied with problems; number one, finding a place to stay in this much damaged city.

Now, as you request, I must recollect my Mexican experiment. I say experiment because, a beginner in Mexico, I encountered several difficulties, although as I discussed them with people well-acquainted with the country I realized that some are not uncommon. The value of the few tips I offer depends mainly on the type of traveler in Mexico. Those who rely on the good graces of the professional tourist agencies will get precisely what the briskly colored posters advertise, but will never know the country shielded from them by the impeccable efficiency of an organized pleasure tour. But to a naturalist or other impecunious wayfarer I might be of some use.

First: transportation. For those planning to drive their own cars, get Doctor Ross to tell about his recent trip into Baja California. Prepared for the worst, they can travel almost any road in Mexico.

Trains I recommend only where there is no other transportation. Getting through from the U. S. border at Nogales, Arizona, through Sonora to Guadalajara or again from Vera Cruz to the Guatemalan border may depend on the railroad. But it ought to be kept in mind that in Mexico only Pullman approaches the U. S. standard. Therefore it is expensive. First class travel on the other hand has little to do with what we call railroad convenience, and so costs less. Finally there is second class, incredibly cheap, the standard rail transport of the local population—ideal for the ordinary visitor who would like to get acquainted with ordinary Mexicans.

The trains have a major weakness. They are slow and usually late, at the rate of several hours per day of traveling. In the course of time I learned to regard this as inevitable, like the diet of tortillas thrice daily.

Then—airplanes and buses. There is a great deal of air transport; in fact, there is no other way of getting to or out of many places (unless you want to hoof it!), and time gained is usually worth the cost. But I suppose the local bus will remain the standard means of getting to any place on a road or excuse for a road. Buses go practically everywhere, even where we thought the road too much for a burro—and they are very cheap.

During the rainy season many trails almost vanish and so a bus trip to the hinterland may become a major expedition. To illustrate: With Dr. Clarence Goodnight of Purdue University and Mrs. Goodnight I traveled to the small coastal town of San Blas in the state of Nayarit. We started from the state capital, Tepic, early one morning in July, at the peak of the rainy season. According to local people we would make San Blas in two and a half hours. We actually made it in five. For the next few days torrential rains kept on increasing in volume, thoroughly devastating the road. The return to Tepic took ten hours; and not only did we pay five pesos per head but Clarence and I had to help push the vehicle which time and again got stuck in the mud, while Marie got out and tramped alongside. The driver was more cheerful. He thought ours was good time because frequently they need fourteen hours for the trip, and occasionally almost two full days. The distance involved, you may wonder? Thirty-two miles.

It may be well to carry as much food as your car will hold, if you go that way. Otherwise, native diet though monotonous can be depended upon. *Tortillas*, *frijoles* (beans), and *cafe* are the staples on which the average Mexican thrives and works extremely hard. Whether you carry your own supplies or not, there is no better way of making friends with the Mexican people than by sitting down to their tables. They are very hospitable, and happy to invite you; refuse, and they'll quite naturally be offended. Once I encountered a group of picknickers on top of Monte Alban. They promptly invited me to join and soon I was partaking of all sorts of the native food including fried grasshoppers. No harm experimenting. True—the following two days I felt as if a swarm of locusts were emerging in my stomach, but I attribute this rather to the rancid coconut oil in which the grasshoppers were fried than to the grasshoppers. In any event I had gained good-will and it was worth the plague of locusts!

The author near Tepic, Mexico.

Drinking may be more of a problem. Dysentery and other infections lurk in untreated water; beer or carbonated drinks will do best. Often, treated water is served—but chlorine tablets will always come in handy.

Much is heard of banditry in Mexico, mostly exaggerated reports. Holdups do occur, but so do they elsewhere. Murders, of which we hear a good deal, usually have personal grudges in the background or some sort of "vendetta." These would rarely involve an ordinary tourist or traveler. I do believe Americans are much safer in this respect than nationals. It is true that in remote villages in certain sections of the country strangers are not welcomed, particularly in some parts of Guerrero and in remote settlements of Yucatan. This attitude in Yucatan, curiously, extends to Mexicans chiefly, Americans being treated in friendly manner.

At present, however, there is a difficulty connected with the *aftosa*, the hoof-and-mouth disease ravaging cattle in a large part of Mexico. Federal sanitation officers are sent out to kill off the infected animals. Owners get certain recompense, yet many resist inspection. An isolated wanderer may find himself under fire, especially if he happens to be monkeying around the cattle. This is why it is wise to let the local people know of your activities, and in case you are collecting insects, show them that the creatures you are after have nothing to do with the dreaded *aftosa*.

Camping out is no great problem in most parts, except that campers should keep an eye on curious strangers who may regard even the commonest items treasure for the taking. If no camping equipment is carried, the numerous hotels and tourist courts will serve. Or on occasion a private family may put the traveler up for the night. Wherever a coffee or banana plantation exists, usually a place to stay will also be found. Of course one must not mind the leaking roofs, punctured mosquito nettings, and roaches and lizards happily roaming on ceilings and walls. Mosquito netting is a necessity in Mexico; malaria exists practically everywhere except in the high mountains. When out at night mosquito-repellent is a must and may, incidentally, also keep other pests off.

One cannot overstress the advantages of speaking and understanding enough simple, every-day Spanish to use it in the casual little daily contacts and transactions with all sorts of people, especially away from the tourist centers.

Where and when to collect, if you are a naturalist, I cannot sum up in so many words. Mexico is an immense country extending almost two thousand miles from Sonora to the Guatemalan border, with varied topographic and climatic provinces. Of its flora Alexander von Humboldt said that it represents almost a cross-section of the world's plant life. Naturally the fauna is also widely varied. Knowledge of general climatic conditions, the amount of rainfall, the time when the seasons set in is of first importance to an insect collector like myself. Any good climatological report, any information from the residents will be useful. The difference between the faunas of dry and rainy seasons is immense. The onset of the rainy season may fluctuate from year to year by several weeks. It may also vary greatly in intensity, particularly in the semi-arid parts. Then there are regional differences. High on the mountain ranges where oak and pine forests grow rains may last throughout the better part of the year. In some places they might occur daily, coming in with clock-like regularity during the noon hours. In the arid regions—most of Mexico is arid or semi-arid—they may last only a few weeks. As the beginning and the end of the rainy season are best for our purposes it is obvious how important is knowledge, even if very general, of climatic conditions. The peak of the rainy season may be as bad for the collector as the dry season. This is a general impression I gained from other visitors and from my own experience collecting during the past summer in the tropical rain forests of the Isthmus of Tehuantepec.

In the tropical regions it is well to keep in mind the slackening of activity during the noon and early afternoon hours, especially in the rain forest. In tropical Mexico and on various Pacific islands (New Guinea in particular) collecting, I discovered, was more or less useless after 11 A.M. Early morning until 9 A.M. seemed to be the best time. In the deep canyon near Tepic falls, Nayarit, I collected butterflies, my chief interest at the time being the huge pearl-white *Morpho polyphemus*. Large numbers of these beautiful butterflies wandered to and fro through the dense wet growth and along the canyon walls. About 11 A.M. they suddenly vanished. In vain I waited the next half hour for a single *Morpho* to appear. Then walking through the forest I discovered that most of these butterflies and their relatives rested under foliage and would fly away as I approached within arm's reach. The insects in general, like the humans and other animals, tend to take *siesta* during those hottest midday hours. The siesta conserves energy, as anyone who does hard physical work in the tropical forests knows well. Mexicans who live on the highlands claim that this is an adaptation to the high altitude. Of course those in the lowlands follow the same custom regardless of their climatic environment. Whatever the reason—it is a good thing!

As you see, I've said virtually nothing of the places one should visit. For that depends entirely on personal interests, and good books are reliable guides. At any rate, the first thing is to get your feet pointing south.

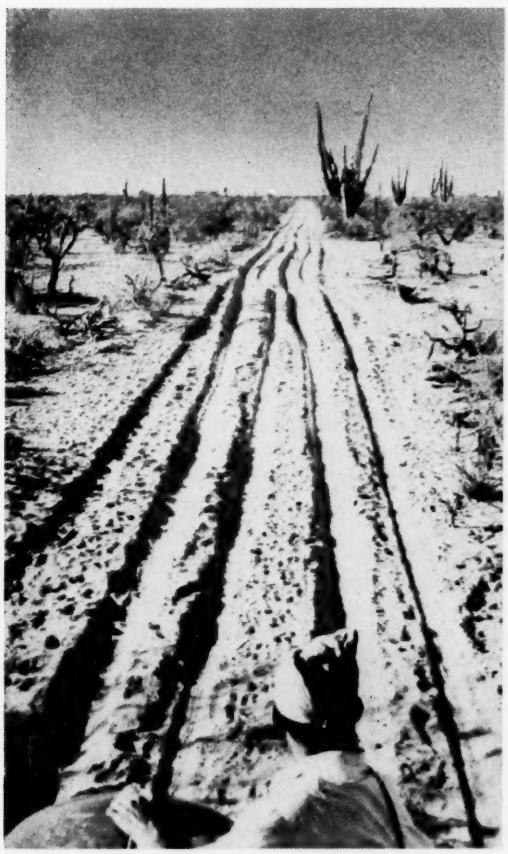
Yours,

BORYS

EDWARD S. ROSS

The Road to Cape San Lucas

THIS TRIP with its vast distances of primitive desert roads and sporadic, widely spaced gasoline supplies, is definitely not for the casual tourist. The relatively few motorists who see the peculiar wonders of this jagged appendage of Mexico have special purpose in their ventures. Many are naturalists desiring to study and collect the strange, often unequaled fauna and flora. Others are interested, for example, in history, especially that of the missions, most of which antedate any of those in our own Alta California. Those who set out solely for a lark usually turn back far short of the Cape, one of the most difficult motoring goals on the Pacific Coast. This trip is likely to be boring to travelers who see the highly adaptive desert vegetation as just so much brush or the fascinating earth sculpture laid bare by weathering as just plain rock.



"A typical desert track"—the silty, rutted road over the parched Magdalena Plain. Near San Domingo, Baja California. The author riding the front fender, on the California Academy of Sciences Expedition of 1941.

The Road

Except for occasional short and unrecommended side routes, there is only one road covering the thousand-mile peninsula of Baja California to its rocky end at Cape San Lucas.

Leaving San Diego and crossing the border at Tijuana one proceeds over seventy-two miles of fair pavement to Ensenada. Recently a wide, newly graded road has been pushed to just beyond Hamilton Ranch (about 125 miles farther south). From this point the road becomes a typical desert track, following lines of least resistance but meeting occasional difficult rocky grades. At Rosario, a small farming village about forty miles south of Hamilton Ranch, the road turns inland and climbs over steep rocky hills covered with weird cirio trees, past San Fernando mission to El Mármol, a large onyx quarry near the center of the peninsula. Thence it strikes out along the peninsula's backbone through a marvelous cactus garden growing on a great extrusion of granite. Large arroyos at and near Cataviña are shaded by stands of *Washingtonia* and *Glaucotheca* fan palms. In the heart of the rocky country, south of Cataviña, the road crosses Chapala Dry (usually) Lake and gradually emerges upon alluvial gravel slopes draining toward the Pacific. In this area we met with magnificent stands of elephant-wood trees which are in full pink bloom in early July. One may touch the Pacific shore briefly near Miller's Landing, but the scene here is bleakly desolate. The almost perpetual fogs have caused a curious, grotesque growth of moss-like plants on the cactus and desert vegetation. This fog desert is unique on the continent.

Leaving the coast, the road continues southeastward to cross the Vizcaíno Desert, passing some interesting volcanic plugs surrounded by rims of rough lava flows. Near Mezquital we saw large numbers of these plugs of varying age in a single vista. The next town is El Arco, a typical Mexican mining camp of little interest but important as a supply center. South of El Arco the road passes near the foothills of the rocky Sierra Giganta and finally, climbing over basaltic mesas, drops into the oasis town of San Ignacio, one of the most charming towns along the way with its picturesque plaza and beautifully preserved, stone, 16th-century Jesuit mission. The canyon has a fine spring and is densely planted with date palms under which grow citruses, grapes, and subtropical plants. There are no suitable hotel accommodations here, but arrangements may be made to camp within the grounds of a land owner.

Leaving San Ignacio the main road turns east, skirting the base of one of the recent Tres Virgines volcanoes. Growing on the basal lava flows are copal trees with whitish, heat-reflecting bark which protects swollen, water-storing trunks. Beyond the volcanoes at the crest of El Infierno grade one has his first glimpse of the Gulf of California, standing out as blue as Lake Tahoe, with San Marcos Island visible in the distance. The road zigzags down the grade with numerous hairpin turns and, after crossing one more main ridge, touches the first beach of the Gulf just north of Santa Rosalía.

For all its reported 12,000 population, Santa Rosalía offers little to the visitor unless he is interested in copper mining; here is the big French-operated El Boleo Mine. This town of frame buildings, uncommon in Mexico, is a good place to gas up, replenish supplies, and have repairs made. Southward, the road improves somewhat, passing through rocky country with occasional vistas of the Gulf. The next town of interest is Mulegé (pronounced Moo-lay-hay′) which has some of the charm of San Ignacio plus a few supply stores. It is not advisable to camp within a mile of this town because of the malaria danger.

Mulegé behind, the road fords the upper end of a lagoon which enters the Gulf and passes southward along the rocky shores of Concepcion Bay. In some places the road is carved out of the cliffs; in others it skirts beaches and mangrove swamps. From the heights we looked down into great depths of clear water and saw fascinating marine life in action. The drive along this bay is one of the most exciting on the peninsula. We found the best campsite at Coyote Cove, a lonely, half-moon beach with excellent swimming and fishing; but, at times the salt-marsh mosquitos may be so abundant here that a camp is impossible unless the party has bed nets. A clump of date palms just behind the beach landmarks the cove.

South of the head of Concepcion Bay, near Canipole, the road forks, enabling a side trip to Loreto, oldest of the Lower California missions, on the Gulf. The right fork climbs across about thirty miles of rocky lava mesas of the Sierra Giganta to Comondú. We came abruptly to the rim of the great arroyo of Comondú, and looked away to a river of green date palms and sugar cane snaking down the valley a thousand feet below. The road winds down the canyon side to the cool verdant shade of the valley floor, where, in season, one may load up with excellent dates. There are two towns—the upper, San José de Comondú, is the site of the old mission; the lower, San Miguel de Comondú, has the most stores and supplies. The road winds southwestward down the gorge which is often lined with columnar basalt. Picturesque wild fig trees with tentacle-like, braided, white roots grow on the sides of the cliffs. The canyon gradually broadens out onto silty, monotonous Magdalena Plain, and the road turns south with the Sierra Giganta becoming only faintly visible in the east. There are but few small towns and ranchos on the plain supplying gas and water. Near San Domingo, watch for the creeping devil cactus growing snake-like on the ground; we did not see it elsewhere on the trip.

Looking west from El Refugio, we saw the heights of Santa Margarita Island forming one of the headlands of Magdalena Bay, but found a side trip to the bay not worth the effort. South of Venancio, at the lower end of the plain, we touched the Pacific shore briefly, finding good rocky spots for observing marine life.

The road quickly turns east, climbs a few hundred feet, then drops to sea level after giving a panorama of our next objectives—La Paz Bay and the Cape region mountains. A few more miles brought us to La Paz (population 5,000), the best town on the peninsula with its excellent hotel, abundant supplies, and garages. One may arrange fishing trips from La Paz, itself the center of a pearl-fishing industry.

South of La Paz, San Pedro is the junction of two routes to Cape San Lucas. One goes by way of El Triunfo down the east side of the Sierra; the other, by way of Todos Santos down the Pacific side. If both roads are open one can circuit the Cape region.

The east route is most interesting, passing through a number of beautiful little agricultural and mining towns—El Triunfo, San Antonio, San Bartolo, Miraflores, and San José del Cabo. After the rains of late summer the countryside may be a mass of green vegetation and flowers—paradise for a naturalist. The little towns furnish supplies, and tropical fruit in season.

Cape San Lucas, rather barren after the foothill region, looms at last—the final goal, land's end. Behind us, the ancient rocky peninsula stretches a thousand miles to its juncture with the continent; before us, it plunges suddenly down into the frothing blue Pacific. Los Frailes are its last rocky outpost, awash in the open ocean.

This mountainous Cape region has been the goal of many an explorer. Burro trips into the mountains for hunting and collecting of specimens are inexpensive and repay in adventure anyone who can invest the time. We arranged such a trip through a rancher at the base of the mountains. From Todos Santos our trail took off into the Sierra Laguna and climbed to above 7,000 feet through rough but highly interesting country to La Laguna, a pine forest with an association of oaks, madroños and other flora, and animal life characteristic of such a place. So like sections of the California coast ranges, La Laguna is the more attractive to naturalists because it is a biological "island," cut off from anything similar by ocean and hundreds of miles of desert.

The Academy Expedition of 1941 stuck in El Tule Arroyo near Cape San Lucas. This was only the beginning; by next morning the rear wheels were out of sight. This time the expedition was lucky: a large crew of Mexicans, sent out to "improve" the road, got them out quickly with the leverage of long poles. Author at right. (Photographs by Betty Hammerly)

Northbound, one can devote more time to areas passed too quickly going south, and—viewed from the opposite direction—the return trip does not seem too monotonous. Some, however, prefer to return by boat. It is possible at times to ship out of La Paz, but usually only to a Mexican port across the Gulf. A regular auto ferry operates from Santa Rosalía to Guaymas, from which an improved road heads directly north to Nogales, Arizona, connecting with U. S. 89.

The Car for the Trip

Although there are many long stretches of road south of Ensenada passable for the modern, low-slung auto, standard passenger cars are not suitable for the trip because of the frequently high, often rocky center of the road, and because of the terrific wear such cars would suffer. There is also the problem of the capacity to carry gasoline, water, food, and camping equipment. Perhaps the ideal vehicle for a party of four is a 1½-ton panel truck with four-speeds-forward transmission, either Ford or Chevrolet, the two makes for which spare parts can most readily be got in Mexico. Some of the surplus Army vehicles are excellent but may give trouble if parts must be replaced. The tires on the weapons carrier are said to be too large and to suffer wear on the sides from the deep ruts. A half-ton panel or station wagon will serve, provided there is good clearance beneath the engine.

Number one of your troubles will be blowouts. Start with new tires. Never drive over cactus; the thorns frequently cause punctures or slow leaks. The many rocks may cause inferior casings to break open. Sharp rocks will cut out large chunks of rubber and may expose cord, especially on sidewalls.

Broken springs are almost unavoidable, but Mexican mechanics are experienced in their replacement.

Getting stuck several times is also to be expected. One should always test the desert crust before driving off the road to camp. Two good jacks are advised, for it is often necessary to raise the rear wheels out of sand or mud and fill the trouble spot with stones or sticks.

Drive slowly. Shift to lower gear *before* attempting grades up or down.

Time to Go

If one is chiefly interested in geology or historical spots, towns, missions, and such things, the best time to travel is during the dry season because then difficulties due to rains (washouts, mud, etc.) are nil. The dry season is almost perpetual from Rosario to San Ignacio, but the rains that do fall here and southward may begin in July and continue sporadically through September. Naturalists prefer the period during or just after the rainy reason. Rains bring out foliage, flowers, and wildlife in sharp contrast to their usual dry dormancy. Danger of being cut off by road washouts is great, however, especially if one hits a *chubasco* —a severe Gulf storm.

How Long it Takes

To drive to the Cape and return the same way takes at least six weeks unless one wishes to drive constantly during daylight hours. Average speed over most of the road will be only 15 miles per hour, and the round trip is well over 2,000 miles—nearly 3,000 allowing for short side trips. Allow for possible breakdown and repair as well as for road troubles such as washouts in the rainy season.

Parties should be equipped for camping out every night except at La Paz. They should be largely independent of the country in food supplies without overloading with heavy canned goods. Water and gasoline may be carried in five-gallon tins, two to a wooden box, on the bed of the car. Gasoline is usually bought in the characteristic Mexican "general store" and not from pumps except in the larger towns. Water is best obtained from deep wells at the ranches or mines and should be boiled for drinking.

EARLE G. LINSLEY

Stars of Early Spring and Summer

The Spring Chart

WITH THE SPRING CHART you are invited to discover the stars of early spring and summer, and to compare star positions with those on the Winter Chart in the last issue. Remember to turn the north side down if you are facing north. The chart will be approximately correct for 8 P.M. the first week in April (no correction for daylight saving time), for an hour earlier the third week in April, and for two hours earlier the first week of May.

Facing north, you will find the Dipper position of Ursa Major now turned upside down. You are discovering the effect of the revolution of the earth around the sun upon the apparent positions of the circumpolar stars in relation to the horizon. This group will appear to rise higher as the season advances until the Dipper group is above the pole star.

Facing south, notice that the winter constellations which were in the east and south have also changed their positions from those on the previous chart. They are being lost to sight in the lingering twilight of the longer days. Aldebaran in Taurus, even more reddish in the twilight, is directly in the west. Orion may still be identified in the southwest but will be lost to view throughout the summer, for the earth in its annual revolution around the sun causes the sun to appear to move eastward above Orion in summer.

Celestial "Landmarks"

It should be of interest to note that on this chart the *ecliptic* (apparent path of the sun) and the *celestial equator* have been drawn. The celestial equator passes through the top star of Orion's belt; the path of the sun passes through Taurus between the Pleiades and the star Aldebaran. On June 21 the sun reaches its highest point in the northern sky, 23½° above the celestial equator; this is the *summer solstice.*

There is of course nothing to mark the positions of these great circles on the celestial sphere; in the planetariums they may be projected upon the dome of the sky in their proper positions. In the sky itself their positions can be located approximately by learning the star groups through which the circles are, figuratively, drawn. On the chart their intersection is in the constellation Virgo. This point is the *autumnal equinox;* on September 22 the sun appears to be in this position. A band 16° wide with the ecliptic in the center is the *zodiac.* At all times in this path will be found the sun, the moon, and the principal planets; Venus, Pluto, and some of the asteroids are exceptions.

In ancient times this belt, the zodiac, was divided into twelve equal divisions, or signs, 30° in length, which were laid off on the charts eastward from the *vernal equinox*—the position of the sun when it appears to cross the celestial equator in March. These signs bore the names of the constellations against which the divisions were projected. Owing to the motion of the earth which causes *precession,* the vernal equinox has, however, moved nearly 30° and the signs if they are to be used must be moved with the equinox. The signs and the constellations for which they were named no longer have the same position in the sky. In learning the positions of the stars and constellations it is convenient to abandon use of the signs. Think of the sun as moving eastward against the background of the sky, in the constellations Taurus, Gemini, Cancer, and Leo, as spring passes into summer.

Brightest Stars

Here are a few of the bright stars to identify and make your friends during summer vacation days. They will seem even more beautiful from the mountains or away from city lights.

Sirius, often called the incomparable, or commonly, the Dog Star, is in the constellation Canis Major, the Great Dog. Brilliant *Procyon* is nearby. Red *Betelgeuse* (Bet'el-juz, giving the *eu* a sound like *u* in *urn*), Procyon, and Sirius make a triangle easily found.

In Gemini, the Twins, well overhead in our latitude in early summer, are *Castor* and *Pollux.* Pollux is the brighter, but some authorities believe Castor was brighter in ancient times. Castor is a beautiful double in a small telescope; each of its components is double in a large telescope. Here are twins indeed!

Leo, the Lion, is easily identified by the portion known as the Sickle (a reversed question mark) and by a right triangle. *Regulus* is at the handle of the Sickle.

Cancer, the Crab, has no bright stars and is hard to recognize in moonlight. Virgo is a long constellation of faint stars except for *Spica* which lies low in our southern sky, the only bright star in a great area of the heavens.

The Planets

Discover the planets by finding bright objects not shown on the chart. There is no favorable op-

portunity to see *Mercury* in the coming months; the best time was near March 17, in the eastern morning sky.

Venus will remain the most brilliant star-like object in the western evening sky, setting about four hours after the sun, reaching its greatest distance east of the sun on April 14. Its magnitude will then be −4.0, very much greater than that of a first-magnitude star. If viewed with even a small telescope it will appear as a tiny half moon.

Mars and Earth were nearest each other in mid-February when the red planet reached its greatest brilliance. It will fade rapidly during the spring and early summer. In April it is but a few degrees from the star Regulus, setting about midnight.

Jupiter in the spring months rises after midnight and is seen low in the south.

Saturn is a few degrees west of Mars during the same period. As Mars fades they will become of equal brightness but in the summer Saturn will be the brighter; Mars and Saturn will draw apart because of Mars' more rapid eastward motion.

ORIGINS OF THE FLORA OF CALIFORNIA. By Douglas H. Campbell and Ira L. Wiggins. *Stanford University Publications (University Series): Biological Sciences, Vol. X, No. 1.* Stanford University Press, 1947. 20 pp. Paper; 50 cents.

The flora of California is one of the distinctive floras of the world, to be classed with those of South Africa, western Australia, and the Iberian peninsula. This article explains the causes that have produced this unique condition in an interesting, lucid, and non-technical manner.

The great upheaval of the Rocky Mountains isolated the Pacific area from the eastern part of the United States and prevented any plant migration. From Sitka to San Diego along the coast the climate is insular and the flora has many species similar as far south as the redwoods and Monterey pines in San Luis Obispo County. In California migration from the east is prevented by the semi-desert Great Basin and the lofty Sierra Nevada range; in the south the deserts isolate it from the Mexican Plateau and the tropics, and on the north the Siskiyou Mountains make a partial barrier.

Between the Appalachian Mountains of the Atlantic states and the Rocky Mountains there are no barriers to migration and the flora is somewhat uniform, many of the same species being found throughout the region. The climate is continental with distinct seasons, a summer of flowering and a winter of dormant vegetation.

California has but two seasons, the rainy and the dry, with great differences in the amount of rainfall. Some parts of northern California will have 100 inches or more while in the deserts in the south there will be only a few inches or none. Differences in temperatures also are great, varying from the arctic of the lofty peaks to the intense heat of the deserts and interior valleys.

The varied topography of the state produces many unlike environments so that altogether a remarkably large flora results, estimated at about 5,000 species with many genera and species found in no other part of the world. Widely distributed genera such as oaks, willows, etc., have representatives in California but the species are all different.

Cultivated areas have a flora of migrants, chiefly from the Mediterranean region, which in many places have driven out the native plants.

In those parts of the country as yet unspoiled by civilization the native flora makes a glorious show, in the rainy season, of plants, especially annuals, essentially Cailfornian. They carpet the ground with color, some species monopolizing large areas and detectable from afar by their distinctive color. These disappear in the dry season when the seeds lie dormant, until the rains begin again in the fall.

Geological development throughout the Tertiary profoundly influenced the climate of the Pacific states. During the Pliocene several floras occurred, as shown by their fossils. The first left traces in broad-leafed evergreens and conifers, some of which have persisted in the mountains of Oregon and Washington, but most of these floras disappeared because of unfavorable changes in environment. Boreal fossils are less in evidence than those from the south. The sequoia forests are areas that were not affected by these great changes. Associated with them are other relicts, the tan-bark oak and the torreya or California nutmeg. The relatives of the former are in Asia while the latter is represented by a different species in Florida, China, and Japan.

The great areas of chaparral represent a different phase of the flora derived chiefly from the southwest element. Among the many genera represented, great differences in species are found in different parts of California with that of the north differing from that of the south and almost all are endemic. Among them, however, the common toyon or Christmas berry is probably a relict since it has relatives so close in the Orient that some botanists class it as a distinct species under the same genus. The same may also be the case of the California peony.

Several lists of species of plants are given which are common to California and other parts of the world. The number of species in each list will give some idea:

Species found from California northward into the arctic and subarctic regions—37.

Species common to California and South America. Most of these do not occur extensively outside the Pacific Coast region. The list contains the majority of species—53.

Species common to California and eastern Asia—15.

The fourth group consists of species that range widely in the northern hemisphere. Some of these occur in the United States and Europe but not in Asia; others are circumpolar in distribution. This list contains the bulk of species common to California and Eurasia—48.

A table of percentages is also given, illustrated by a bar-graph showing the geographical distribution of the species comprising the present flora of California in areas covered by known distribution. There are sixteen different areas from which distribution has come. These lists would be interesting only to those who know the species by name.

I quote the concluding paragraph which summarizes the causes of this peculiar flora:

"The distribution of the existing flora of California indicates that the majority of the endemic species originated in their present area. The 'relict' species, such as the redwood and some other conifers, like the cypresses, perhaps represent the late Mesozoic flora that had developed before the complete isolation of the area. Such cosmopolitan genera as *Acer, Populus, Quercus, Salix,* and the like, probably reached California from the north via the Coast Ranges and the Sierra Nevada. The California species are much changed, presumably due to the altered conditions of climate and environment resulting from the southward migration. The Cactaceae and some other genera which California shares with Chile and Mexico are undoubtedly of southern origin."

In the hope of giving to the general reader some idea of the comprehensive scope of this article, the details such as the scientific names of the plants are not given. These, of course, make it more alive and interesting to the botanist.

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WEST COAST SHELLS. by Josiah Keep. Revised by Joshua L. Baily, Jr. Stanford University Press. 1947. xii + 350 pp. 334 figs. $3.75.

A prospectus of the 1911 edition of this work stated: "It will be found of the greatest assistance to those who visit the seashore, and it should also have a place in all school and public libraries as a book of reference, it being the only descriptive book which treats fully of our Western Shells." The book was well received by the public and within a few years was out of print. A new edition revised by Joshua L. Baily, Jr., was issued by the Stanford University Press in 1935. The supply of the revised edition was exhausted within the next ten years and the present volume, a reprinting, was issued by the same press in July, 1947. The same size and format have been followed but unfortunately some of the line cuts used for illustration are not so sharp in detail as in the earlier edition. Other books and pamphlets dealing with western American shells have appeared from time to time but Keep's volume retains its value as a handbook among both amateur collectors and scientists. The text is written in language which is both interesting and readily comprehensible to the layman yet without loss of factual information appealing to the specialist. Those who heard Professor Keep lecture at Mills College, on the Chautauqua, or in other public appearances, agree that he had the ability of the born teacher to interest and inspire. The first edition published under the title of *West Coast Shells* in 1887 contained 230 pages and 182 figures in the text and one colored plate. The continued demand resulting in subsequent editions is adequate evidence of its appeal to the public. It is a pleasure to announce the reprinting of this work by Keep who in 1881 was Curator of Conchology in the California Academy of Sciences.

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GLACIAL GEOLOGY AND THE PLEISTOCENE EPOCH. By Richard Foster Flint. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., London. 1947. xviii + 589 pp. 6 map pls. 88 figs. $6.00.

This book deals with the Pleistocene from the viewpoint of a glacial geologist, and is frankly admitted by the author (who is Professor of Geology at Yale University) to be a one-sided treatment. In consequence, the uninformed reader may be over-impressed by importance of glaciation and related events in respect to other geologic events which also occurred during this same interval of time. However, the book is an ex-

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cellent treatise on the processes of glaciation and the last great ice age, which, according to the author, is still in progress.

The first ten chapters are devoted to defining and explaining the various glacial processes and terms, concluding, in most cases, with one or more typical examples, together with the inferences to be derived from them. This section of the book makes an excellent basis for anyone interested in studying glacial geology, and should be read by all geologists who are working in glaciated areas.

In Chapter Eleven, which is entitled "Glacial Stratigraphy," the relationship of glaciation to Pleistocene stratigraphy in general is discussed, certain peculiarities of glacial deposits as compared to conventional sedimentary deposits are elaborated upon, various means of determining the relative ages of glacial and related sediments are described, and the "Post-Pliocene" stratigraphic terminology used in the second part of the book is introduced and defined. Flint provisionally defines the Pleistocene epoch as "that part of late-Cenozoic time which is characterized by repeated climatic cooling, involving repeated conspicuous glaciation in high and middle latitudes, repeated pluvial phenomena in middle and low latitudes, and related worldwide fluctuations of sea-level. It is also marked by the appearance and intercontinental migration of the modern horse, cattle, mammoths, camels, and man." According to this definition, we are still living in the Pleistocene, whereas conventional usage usually terminates the Pleistocene with the close of the last widespread glaciation as compared with the present restricted glaciation. As defined, the beginning of the Pleistocene is difficult to recognize, for the inception of glaciation in the middle and lower latitudes did not occur at the same time as in northern latitudes, and the probability is great that we will never be able to accurately date the beginning of glaciation in the Arctic and Antarctic. Similarly the criterion of worldwide fluctuation of sea level is difficult to apply, for as Flint says, "Fluctuations due to glacial activity can only be recognized on coasts that have not suffered orogenic movements since the time of glaciation." If the above definition of the Pleistocene is accepted, then the Pleistocene of North America will have to include part of the well-recognized Upper Pliocene of Europe.

In his thinking, Flint has not clearly separated time stratigraphic units from rock stratigraphic units as evidenced by the statement on page 204, "The time unit represented by its deposits began much earlier in some places than in others." Yet any time unit must begin at the same instant, no matter what the geographic position be; if it did not, then the Pleistocene of one area would be equivalent to the Pliocene of another area. The geologic time unit must be universal—it need not be represented everywhere by rocks, but it must have the same time value or else geologic chronology would be chaos.

The last twelve chapters are concerned with the description and chronology of glacial events over the world with the major emphasis on North America, although all the outstanding events in the glacial stratigraphy of the rest of the world are covered in more or less detail.

Four glacial stages are recognized in North America, from oldest to youngest, respectively: Nebraskan, Kansan, Illinoian, and Wisconsin. These are correlated with the four Alpine stages, in the same sequence: Günz, Mindel, Riss, and Würm. It is considered probable that everywhere in the cool temperate and polar latitudes there was similar glacial activity during these same intervals, that there was a corresponding pluvial period in the warmer latitudes, and at the same time worldwide lowering of sea level corresponding to the withdrawal from the oceans of the water tied up in the glacial ice. Correlated with this last fact, Flint considers that there will be a general rise of sea level of between 66 and 165 feet when all the water tied up in existing glaciers is released. He further estimates that at the time of maximum glaciation sea level was about 395 feet lower than at present. During the time of maximum glaciation about 32 per cent of the present land area was covered by glacial ice. Various calculations indicate that the mean annual temperature during the glacial stages was from 3° to 8° C. lower than at present, a relatively small change. During some of the interglacial epochs, there is clear evidence that the mean temperatures in northern latitudes were higher than at present.

Flint finally concludes that glaciation is probably due to two factors: One, fluctuation of solar radiation as the cause of worldwide temperature changes; and two, the presence of highlands as the prime factor determining the accumulation of snow and the distribution of glaciers. He terms this the *"solar-topographic hypothesis,"* but does not claim that it is original with him. He believes that lowered solar radiation, in combination with numerous high mountains, causes the accumulation of ice in such quantities as to form extensive glaciers.

The book is concluded with a 40-page bibliography on glaciation. A number of typographical errors, such as "Pelistocene" for Pleistocene, and "Illionian" for Illinoian, occur, and on page 163 three lines of type are misplaced. In general, however, the book is well put together and it is a work that will stand as a classic text on glaciation for many years.

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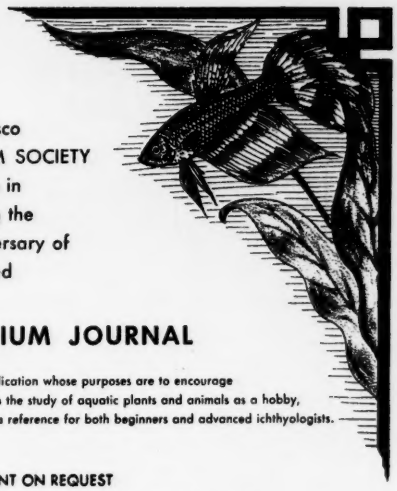

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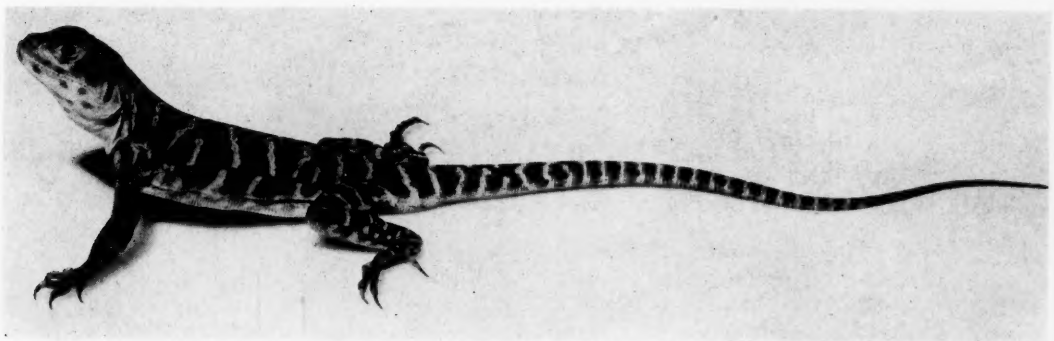

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